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Junkets

WITH the advent of spring the delights of travel make their appeal, especially if the expenses are borne by some big-hearted philanthropist. Lest they grow up in an atmosphere of provincialism, a committee of the council of an Alabama city, charged with the expenditure of funds for street-pavement work, is planning a visit to Kansas City to inspect a certain type of paving. The manufacturer of this type, if press reports are to be believed, is financing the trip to Missouri, where the city fathers "will be shown." Puzzle: When the committee returns home and has digested the technical data it has absorbed, what kind of paving will it recommend?

The Passing of a Type

HANDLING men, as opposed to driving them, is rapidly replacing the old-fashioned method of doing work. The bullying, blustering, foul-mouthed walking boss of but a few years ago is rapidly disappearing from construction work, and the quiet-spoken, tactful superintendent, quite frequently an engineer, is taking his place. The change marks the passing of a type. The laborer of today is a different kind of man from the laborer of ten years ago; the increasing proportion of plant and mechanical equipment on construction work has brought about the change. The proportion of skilled workmen to the kind whose intelligence is equal only to the wielding of a pick and shovel and the use of a wheelbarrow has been greatly increased. The old type of workman expected browbeating and even brutality. But the new type resents it, even to the point of refusing to work. The thinking contractor realizes the change that has taken place and adapts his methods to suit. His aim is to get the maximum output from each man and, to accomplish it, he devotes his efforts toward developing a spirit of co-operation, of enthusiasm and of interest in the work.

The Cost

WHAT the European War is costing the engineering profession and, in turn, the progress of the world is, with the meager information at hand, impossible to calculate. Yet in all the armies, fighting shoulder to shoulder with their less gifted brethren, are many prominent engineers. How many of them have been killed or will be killed no one can tell, and how much the progress of the world will be set back with each death can only be imagined. It was hardly to be expected, however, that the war would exact a bloody toll from the membership of the profession in our country, yet the Lusitania has gone down carrying with it at least three American engineers —Dr. F. S. Pearson, A. L. Hopkins and Lindon Bates, Jr. To engineers generally the best known of the three was Dr. Pearson. His was the rare pioneer courage that pushed forward into unknown lands and so inspired the confidence of his associates that they were willing to risk fortunes in hydroelectric and other enterprises in new countries. Necaxa, the hydroelectric plants near Rio de Janeiro and Sao Paulo, and Seros, in Spain, among dozens of others, stand as monuments to the ability and enterprise of this courageous representative of the American engineering profession. The world can ill afford to lose such men as he.

Success with Penetration Roads

SO MANY engineers have returned with optimistic reports from an inspection of the bituminous roads built according to the penetration method by the Massachusetts Highway Commission that the article on page 608, describing in detail how the work was done, should appeal to an audience beyond the limits of the Bay State. The feeling has been growing that mixed roads are better than penetration roads, though this journal has unqualifiedly expressed its faith in the penetration road if properly laid. Mr. Pillsbury, division engineer in charge of the work described in this issue, is equally positive that the penetration road can give a good account of itself. It is apparent from the account, however, that, in Massachusetts, great stress is laid on careful attention to details. The outstanding features of the method of construction are: First, the preparation of a well-drained and thoroughly compact subgrade; second, the use of large stone—from 1½ to 2 in.—in the top, or wearing, course, and, third, the application of the bituminous material by an air-pressure distributor instead of by hand-pouring. The chief argument for the large-size stone for the wearing course, which is considered a very important factor in the success of the penetration work, is that it binds well in the surface and, therefore, does not move under traffic. With large-size stone there is less tendency to ravel, even when the life of the binding material is partially destroyed. Although various types of binders have been used with good results, preference is given to asphalt for roads carrying the heaviest traffic. It is essential that the binder be applied uniformly and, obviously, this is best accomplished by machine distribution. It is still too early to draw final conclusions as to the latest innovation in the Massachusetts penetration work, the tar-sand method, but although it is somewhat more costly than straight penetration work it gives promise of excellent results and will be used this season. There is no place for slip-shod methods in any form of bituminous-road construction and the excellence of the Massachusetts work is attributable to careful attention to details in drawing the specifications and to their rigid enforcement.

The Welland Canal

FOR years the interest of those who follow the engineering of waterways has been centered in the Panama and the New York State Barge canals. They were tremendous projects, replete with details of the greatest interest to engineers, both in design and construction. Now that the work of building them is drawing to a close, interest will probably shift to the construction of the Welland Ship Canal, on which the Canadian Government will spend $50,000,000. And well will it deserve the attention previously given to Panama and to the New York work. Only those who have had occasion to look into the Welland designs carefully appreciate fully the magnitude of the enterprise. In length it is not notable. Its locks, however, will stand with the great ones of the world. They are to have clear inside dimensions of 80 x 800 ft., with 30 ft. of water on the sills, while each of them will have the great lift of 46½ ft. At Thorold will be constructed a flight rivalling that at Gatun, for though the locks themselves will not accommodate as big a vessel the lift will be greater. At this point there will be three of them in flight, each with a lift of 46½ ft., or a total lift of 139½ ft. Moreover, as at Gatun, the flight is double, one for upbound and the other for downbound vessels. In details the locks will be very interesting. The most unusual feature will be the use of swinging single-leaf gates. The adoption of this design followed only after a most careful study of all other alternatives. It would not be surprising if the Canadian peninsula just west of the Niagara River should become a Mecca for canal engineers during the next few years.

Fire Hazard on Bridges

IN the news pages of this issue will be found views of steel bridges at Detroit and Vancouver, totally destroyed in one case, seriously damaged in the other, due to the burning of the wooden floor systems and paving. The proximity in time of these two occurrences reminds one strongly of two occurrences in the summer of 1913, when the Armour-Swift-Burlington Bridge, at Kansas City, and the Harriman Bridge, at Portland, Ore., were similarly damaged. An editorial in this journal of Aug. 23, 1913, page 197, might well be reprinted at the present time, the thoughts being just as pertinent to the recent occurrences as to those specifically commented on almost two years ago. Nor are these the only instances of serious damage to important steel structures through failure to provide an incombustible floor system. Certainly the instances have been sufficient in number to warrant a very strong stand against combustible floor systems and paving, though the damage is likely to be much less if wood-block surfacing be laid on buckle plates, flat plates, or concrete slabs. So large a proportion of a steel-bridge structure is noncombustible that engineers are apt, without thinking, to consider such bridges free from fire hazards and thus neglect to evaluate the objectionable features of a wooden floor system. We have long since learned that a so-called "fireproof" building may be noncombustible, so far as its frame is concerned, but that, for that mere reason, it cannot truly be said to be fireproof. We need to appreciate just as keenly that the same argument applies to the steel bridge. Failure to evaluate properly the fire hazard must, henceforth to say the least, be considered a mark of negligence or incompetence on the part of the engineer in question.

Filtration at Wheeling

WHEN technical questions are submitted to the citizens of a community for decision by popular vote it is pretty safe to look for trouble. Ottawa's notorious "plebescite" on the question of the source of the city's water supply is a case in point. A more recent instance of this absurd policy has occurred at Wheeling, W. Va., where the citizens were called on to vote, not upon the broad question of whether or not to filter the city supply, but upon the type of filter to be installed. Obviously a decision of this character should be made only by properly qualified experts and not by laymen, even though the latter be actuated by the best intentions. The vote was overwhelmingly in favor of the so-called Smith system of filtration, in spite of the fact that a filtration commission, of which George A. Johnson, consulting engineer, of New York, was a member, submitted a report condemning this method of purifying the city's supply. The system approved by popular vote consists, in its essence, of a manifold of perforated pipe laid in the river bed and covered with gravel and sand—obviously a difficult installation to handle if the pipe should clog or the system need repair. But in spite of the advice of its filtration commission, which recommended mechanical filters, the city voted for the system which will be submerged in the muddy bed of the Ohio River. This week a ballot will be taken on a bond issue of $640,000, which, if approved, will be devoted to the construction of the Smith system, and no other. It may be that this system will deliver a satisfactory water, but that is not the question here raised. The city has been advised by qualified engineers that the system approved by the voters, who know nothing of the technical questions involved, "would not be a wise investment." Many communities are paying dearly for neglecting the counsel of their technical advisers. By defeating the bond issue, Wheeling still has a chance to secure a filtration system which will conform to the best modern practice. The health of any community depends to a large extent upon the quality of its water supply and a filtration plant is not a suitable toy for politicians to play with.

The Motor Truck and the Road

IN a general way it has been realized that the heavy motor truck brought with it a new set of road problems in addition to those introduced by light motor cars. The latter problems are well on the way towards solution, if not wholly solved. The motor-truck problems are entirely different. Aside from the obvious need for heavier foundations and stronger highway bridges, heavy-truck traffic calls and calls loudly for investigation as to the peculiar effects of truck tires on road surfaces.

In the case of the pneumatic tires of fast-moving pleasure cars, this effect is one of back thrust and suction. Rounded truck tires have an entirely different effect; namely, that of pushing the road surface outward at right angles to the direction in which the wheels are moving. No inferences useful in determining the effect of motor trucks can be drawn from observation of heavy horse-drawn loads for the reason that vehicles with square-edge iron tires carrying no more than a normal load for two horses compress road surfaces vertically—a result rather desirable than otherwise, and certainly a very different effect from that of rounded solid-rubber truck tires.

This one fact is typical of the things in regard to motor-truck traffic that should be under close investigation now. If it is as important a factor as it appears to be there should be an effort to encourage the use of flat, square-edge solid-rubber tires rather than those of rounded shape, though the ultimate solution of the problem as a whole will come in the building of roads that will withstand whatever traffic or tires of reasonable shape and width pass over the highways. It is also plain that the right-angle push of the motor-truck tire calls for immediate reconsideration of opinion as to the necessity for lateral support, in the form of curbing or headers, for certain types of roads.

This is but a superficial consideration of the problems the motor truck has brought up for solution, the present purpose not being to decide these problems but to urge their investigation by those whose business it is to sense and anticipate highway needs. A bulletin (Circular 49) that has just been issued by the Department of Agriculture on "Motor-Vehicle Registration and Revenues, 1914," reports 44,355 trucks licensed last year. The motor truck is here to stay and to increase in numbers and weight. Road builders must meet the new and severe demands it makes upon highways not only in and near cities but in farming districts as well.

Will Chicago Step Backward?

DURING a period of seven or eight years Chicago has been building up within its civil service commission an efficiency division which has set the pace for civil service work throughout the country. The division's activities were predicated on the theory that it was the commission's business not only to examine applicants and certify them for appointment but also to keep in touch with the work of employees and, in general, assist in building up more efficient organizations in the various city departments. Standards of employment have been set up, positions carefully classified, grades equalized, salaries placed on a uniform basis, lines of promotion, based on duties and responsibilities, carefully defined; correct organization systems installed, standards set up for measuring the service rendered by employees and thus determining their efficiency. Cost systems have likewise been installed which have proved very illuminating and valuable for department heads. When any particular service seemed to be operating unsatisfactorily, the efficiency division made the necessary studies and, in co-operation with the line officers of the particular bureau or department, worked out a scheme of more efficient administration. The last report of the civil service commission—for the year 1914—shows that excellent progress has been made on all of this work. Without the expert advice and assistance of the efficiency division, the commissioners state, standardization of the city service as above outlined would have been impossible. So convinced was the previous commission of the excellence of the work that it recommended that in any plan of charter revision for Chicago consideration be given to continuing and extending the work of the efficiency division, or that in lieu thereof provision be made for some other permanent body with like aims and objects.

There are indications that the new city administration is not in sympathy with the work of the division. The chairman of the commission has summarily reduced the force by half and dispensed with the services of the division's expert on system and organization, J. L. Jacobs, whose work has been of the greatest value and who, among other duties, has assisted in preparing the annual budget submitted to the city council. The chairman of the commission claims that the division was being operated inefficiently and, of course, he is in the right if careful consideration has proved that the reduced force will be sufficient. That careful consideration, however, will probably be found to be lacking. The move is ominous, indeed, and, if it presages the crippling of the efficiency division, will be a decided step backward.

The present Chicago administration went in with a tremendous majority on a platform of economy. If it interpret economy to mean saving at the spigot and wasting at the bung-hole, which the reduction of the division forecasts, it will soon find itself in the condition of the New York State administration under Governor Whitman, which went in acclaimed as the salvation of the State but has been a bitter disappointment. If the Chicago administration wants to learn what will happen if it cuts off the bureau which is in the best position to aid it in fulfilling its election pledge of economy, it can do no better than to study the situation at Albany.

Housing and Health

THE struggle for good housing conditions in our cities is being carried on with increasing vigor. The problem is being attacked by different groups—by social workers, by economists, by architects, by business men with real-estate interests, and, more recently, by city planners. One of the most important reports, containing recommendations for constructive legislation, is that of the Massachusetts Commission of Building Construction, recently sent to the Legislature of that State. Its essential features are minimum building requirements State wide in their application, enforced by a State Building Department consisting of a highly paid commission and an advisory council, and provisions for co-ordination of State control with that of local authorities. In scope it covers all phases of building construction, such as strength of materials, plumbing, ventilation, regulation of building heights, areas and fire prevention. Various cities, through tenement-house legislation, have attacked the question, while in New York City the City Planning Commission is wrestling with the problem on an immense scale. Are sanitary engineers interesting themselves in this subject as much as they should? Are the newer ideas in sanitation being embodied in the laws now making?

The argument for better housing has always been that better housing means better health and that bad housing means disease. Is this argument sound? The proof advanced has usually been inductive. Comparisons have been made between different housing conditions and the amount of sickness among the dwellers. Undoubtedly bad housing has been associated with disease. But so has poverty, so has overcrowding, so has lack of nutrition, so have over-work and discouragement. Have high death-rates borne a relation to housing conditions? We do not know positively. It is practically impossible to give tangible statistical proof of it apart from the other factors. If we apply some of the newer theories of bacteriology deductively we see but little reason why bad housing should directly enhance the spread of communicable diseases under ordinary conditions. Some chances there are, to be sure, through the agencies of insects and rats. But sewer air does not spread disease, houses do not become culture chambers for germs, air even in confined quarters does not to any important extent waft bacteria from the sick to the well. It is the habits of the people themselves that must be bettered if communicable diseases are to be lessened.

But must we not also face the fact that absence of disease does not necessarily mean health? There is a positive quality to health that is important and that needs to be considered in this matter of housing. Granted that sewer air may not spread disease, may it not impair the health of one who continually breathes it in diluted form? Are not light and air and space necessary to health, considered as a positive quantity?

There is need for a new series of vitality statistics, which shall do for hygiene what vital statistics have done for sanitation? It is only as a scientific idea is studied quantitatively that it advances in practical usefulness. Ought we to expect that housing will advance as an art until we can measure its hygienic influence in a quantitative manner? This is a problem for both physiologists and engineers. To devise and use a new series of health measurements will take time. Meanwhile the problem must be tentatively solved and hence the best knowledge and foresight which sanitarians, physiologists and engineers possess should be brought to bear upon it.

Turbine-Electric Propulsion for Battleships

OUTSIDE the purely military problems of naval engineering, the question of electric propulsion for battleships is today one of the most important for consideration by governmental authorities responsible for the design of high-powered fighting craft. In a paper upon this subject in the "Journal" of the American Society of Naval Engineers, Lieut.-Commander P. W. Foote, U.S.N., reviews the status of battleship propulsion by reciprocating engines, direct-connected, geared and electric-turbo units and concludes that while turbine-electric drive has yet to be tested in a battleship installation, it promises to be superior to every competitor to an extent that will represent a distinct epoch in the engineering military efficiency of the Navy.

The acceptance of the collier "Jupiter" by the Government after tests in which this pioneer turbo-electric vessel surpassed the requirements pointed the way toward even more suitable applications of this type of equipment. The discrepancy between the economical speeds of turbines and of propellers has been so great in the past that reduction through mechanical gearing or by the electric motor has become well-nigh absolutely essential to the kind of service demanded in the modern navy. Facility of control, economical operation at moderate speeds employed in cruising and efficient use of power at high speeds through heavy seas are points of immense importance to battleship or cruiser. These appear to be capable of greater realization with electric drive than with any other method of propulsion. Simplicity, the use of well-tried equipment, and service reliability demonstrated by over a year's operation on the "Jupiter" are on its side. In manoeuvering and backing the flexibility of electrical operation is of great value, and the single advantage of being able to maintain top speed in any sea with the electric drive, with no racing of propellers, might alone become the deciding factor in a naval campaign.

The double "squirrel cage" induction motor exactly fulfills the requirements for ship propulsion where wide variation of loads, speeds and operating conditions is found. Since the speeds of motors and turbo-generators depend upon the inverse relation between their poles, a reduction from the efficient turbine range of 1200-3600 to the efficient propeller range of 100-125 r.p.m. is readily obtained. Electric propulsion, however, does not lend itself so well to ships of small horsepower because the size of the motors mechanically limits the number of poles and the speed reduction is much more limited than in ships where large motors can be used. About 5000 shaft horsepower is roughly the present minimum for electric propulsion, mechanical reduction gearing being generally more efficient and desirable below this power unless facility of control is paramount.

The electric drive permits great facility of control either from the bridge, conning tower or any fire control station, and in this point far exceeds the reciprocating engine, direct-connected or geared turbine. The propeller may be started, stopped or run astern by a simple hand movement remote from the turbine room, and, similarly, turbine speeds may be electrically governed from a distance. The type of induction motor mentioned above allows as high backing power as the propeller design permits, and in this way equals the reciprocating engine and far excels the turbine mechanical-reduction gear. Throughout the electric installation the equipment is generally operating near its rated load, which spells economy with capitals. Considering all the military and economical characteristics desired in a battleship, turbine direct-connected ships are not the equal of reciprocating-engine vessels, even when the former are fitted with cruising turbines having mechanical-reduction gears. Reduced complication, decreased weight of machinery and boilers, economy of space and low maintenance requirements are closely identified with the turbo-electric drive; the danger of troubles in circuits is nominal, and the subdivision of the turbine room into watertight compartments is greatly facilitated with the electrical installation. Constant-speed vessels, like merchantmen, have less to gain in the use of the electric drive, but warships of high power are certain to find it of great value unless difficulties which are not yet apparent develop in service.

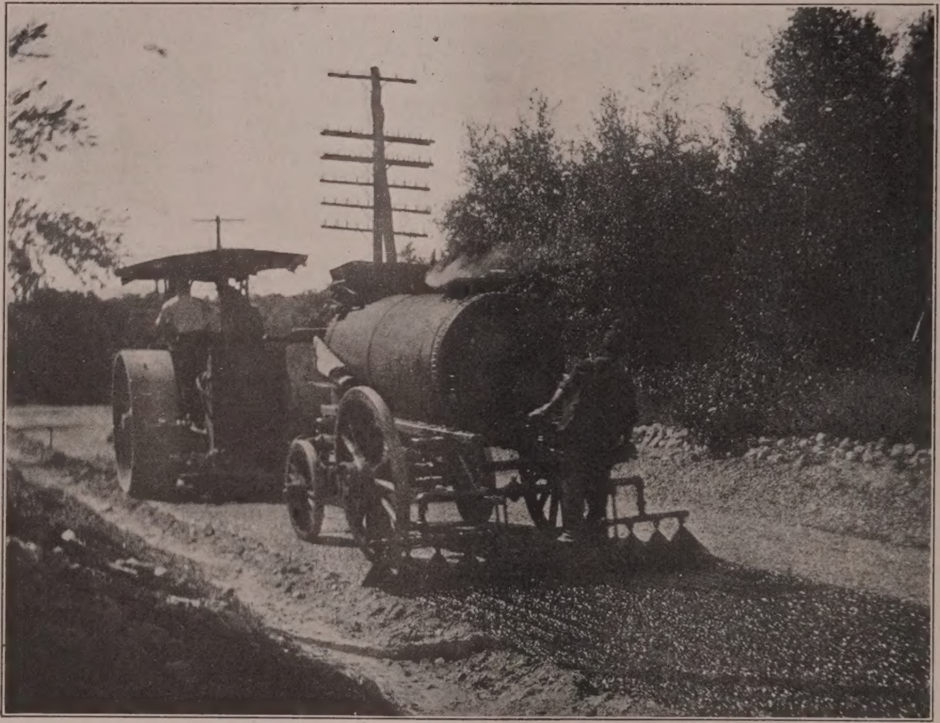
The U. S. Navy Department has decided to provide turbo-electric propulsion equipment for the 32,000-ton superdreadnought "California," the largest battleship ever planned for this country's service, and the record of this vessel will be watched with interest by engineers and seamen the world over.

Bituminous Penetration Roads in Massachusetts Equal Those Built by the Mixing Method

Success of State Highway Commission's Work Attributed to Use of Large Stone in Top Course, Application of Binder Under Pressure, and Careful Attention to Construction Details—Tar-Sand Method the Newest Feature

"UNDER certain conditions the penetration method, using a natural asphalt binder, will produce roads fully as satisfactory as are obtainable with the mixing method if proper attention is given to construction details."

This assertion, in direct opposition to the views of the majority of road builders by whom the mixing method has been regarded as the superior type of construction, was made recently by F. C. Pillsbury, division engineer of the Massachusetts Highway Commission, and is based upon an extended experience with penetration wrok in the Bay State. On the Massachusetts highways two types of bituminous road construction by the penetration method were used last year. The first involves the use of large stone, ranging in size from 1½ to 2½ in., for the wearing course, and the application of the binder from a pressure distributing machine. The essential feature of the second method is the mixing of heated sand with tar prior to its application to the road surface, following a practice which has been used to some extent in England recently, but which has not found a wide field of application in this country.



WHILE GOOD RESULTS HAVE BEEN SECURED BY HAND-POURING THE BEST WORK HAS BEEN DONE WITH AIR-PRESSURE DISTRIBUTORS

To a representative of the Engineering Record Mr. Pillsbury explained recently the details of the two methods of construction as used on Division 3 of the Massachusetts Highway Commission work. The following notes are based on this interview.

SIZE OF STONE IMPORTANT

The size of stone in the top course is regarded as a matter of vital importance in the construction of a road by the penetration method. The Massachusetts Highway Commission employs stone ranging from 1½ to 2½ in. in size. The large stone, it has been found, binds together more firmly than smaller stone and consequently is subject to less wear from the grinding of one fragment against another in the body of the pavement due to the passage of vehicles over the road surface. Small-sized stone tends to loosen quickly under this grinding action, and if the bituminous binder loses its life and is not speedily renewed the road quickly goes to pieces. With stone of large size no such result may be expected. It is true that with the larger stone the voids are greater and consequently a larger amount of bitumen must be used to fill them, the excess being generally about ⅜ gal. per inch depth of top course for the large stone type of construction. Thus a small stone pavement with tar as a binder and a 2-in. top course would cost about 6 cents less a square yard than the large stone type of pavement. In spite of this slight increase in cost the large stone is believed to be amply justified. With small stone it is practically impossible to secure any great depth of penetration with a single application of bitumen. It becomes necessary, therefore, if small size stone is used, to build the top course in several layers and apply the binder to each—obviously a more costly procedure than the distribution of the binder in a single operation, as is feasible when large stone is used.

As to the quality of the stone in the top course, this depends to a large extent upon the character of the traffic to be handled. For very heavy teaming the Massachusetts Commission believes that the best results can be secured with trap rock and a high grade asphalt. With a tar binder, instead of asphalt, a softer grade of rock is permissible, for the tars deteriorate more quickly than do the asphalts. Asphalts are preferred because of their greater cementing value and their higher resistance to disintegration by moisture.

PREPARATION OF SUBGRADE

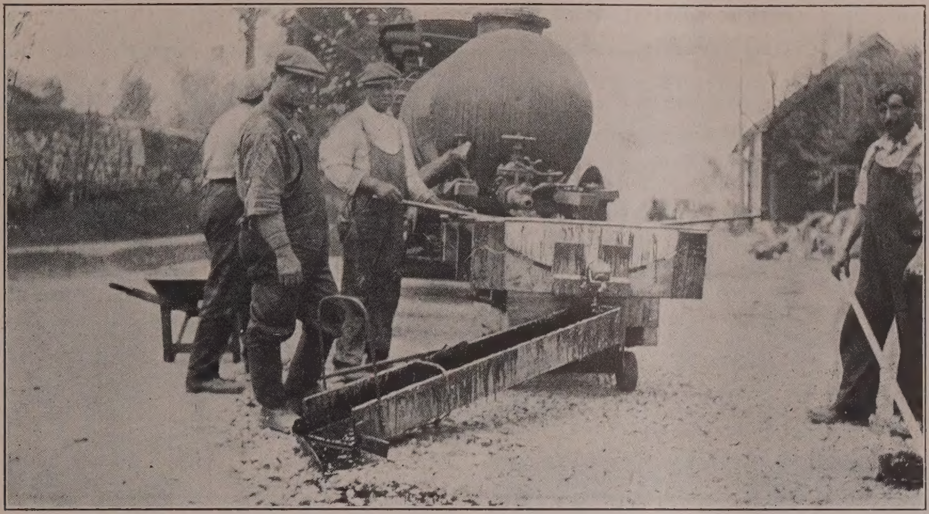
The first step in the construction of a road by the penetration method, according to the Massachusetts standards, is the provision of adequate drainage. In loamy or clayey soils it is common to put in a subbase of gravel 1 ft. thick or a telford base from 1 ft. to 18 in. thick. The telford base may even be underlaid by a layer of gravel not exceeding 8 in. and the interstices at the tops of the stone filled in with smaller sized materials. In springy ground stone drains with open-jointed sewer pipe are insisted upon. These are located at the sides of the road when the grade is level and on the uphill sides if along a hill. It is important that this sub-base be thoroughly compacted and it is therefore rolled with a 10-ton steam roller until no settlement is discernible.

Upon this base course is spread a layer of broken stone from ½ to 3 in. in size which is compacted to a depth of 4 in. after rolling. This forms the bottom course for the penetration roads. There should not be too much fine stone in this layer. After it has been thoroughly rolled the pieces in the bottom course are partly bound by filling the interstices with smaller sized stone, sand, screenings or stone dust. For this bottom course the size of the stone is not of particular importance. It should, however, not be bound too thoroughly and may or may not be sprinkled, depending upon the nature of the material. It must, however, be rolled until thoroughly compacted. This is most important, for if the base is not rigid depressions will develop in the wearing surface. The bottom course is placed generally in several spreadings and varies somewhat, due to the nature of the foundations and the character of traffic. If placed on an old macadam roadway 2 in. of new stone may be sufficient; for a new roadway to carry heavy traffic it may be necessary to use 5 in. of stone in the bottom course.

TOP COURSE

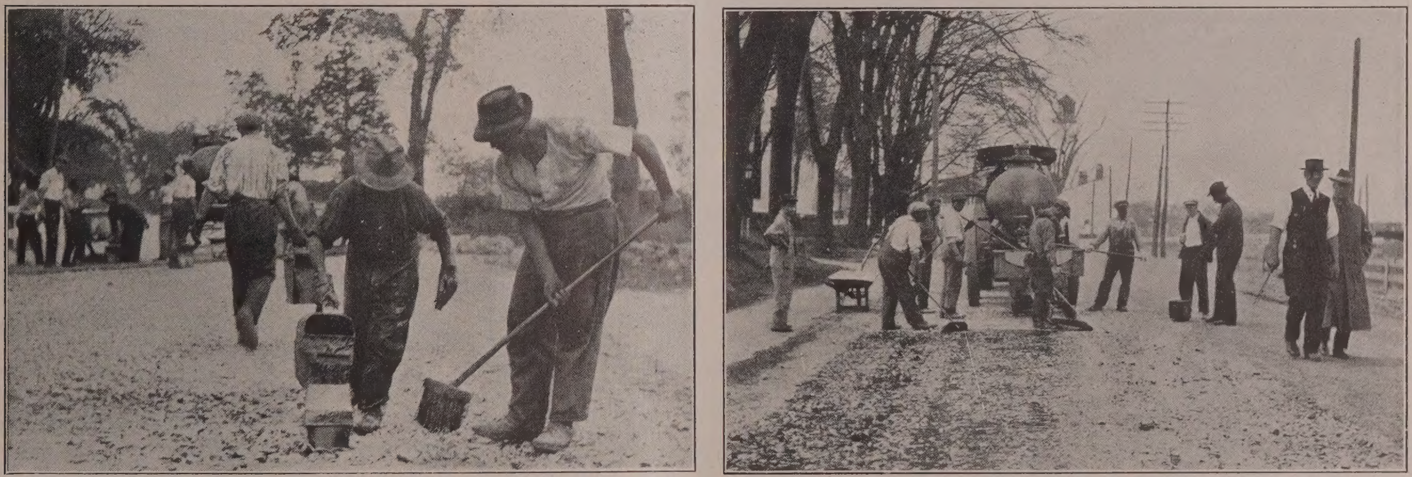
The methods outlined for the base apply to all types of bituminous macadam construction. It is next in order to describe the top or wearing course for heavy traffic conditions.

Upon the base prepared, according to the method outlined, the best results have been secured by spreading trap rock varying in size from 1½ to 2½ in. to a depth of 2 in.



IN THE TAR-SAND METHOD, AS DISTINGUISHED FROM STRAIGHT PENETRATION WORK, MATERIAL IS DISTRIBUTED BY A TROUGH AND BROOMED INTO SURFACE BY SQUEEGEES

after rolling. This 2-in. thickness for the wearing course is sufficient for ordinary traffic, but for exceedingly heavy traffic the top course might be made 3 in. and placed in two layers. The stone is carefully spread from dumping boards, thoroughly rolled and all depressions filled. No sprinkling is allowed on the top course.



THE TAR-SAND MIXTURE HAS BEEN APPLIED BOTH BY HAND-POURING AND BY TROUGHS FROM HEATING MACHINES

When it shows no movement under the steam roller the top course is ready to receive the bituminous binder. While good results have been secured by hand-pouring, the best work has been done with pressure distributors using air for pressure.

Preference as to Binders

Mr. Pillsbury's preference for binders on penetration work is as follows: First, lake asphalt; second, oil asphalt; third, tar. Tars, he states, have stood up under traffic which the oil asphalts could not bear, but the disadvantage of the tar is that it does not retain its life as long as the oil asphalt.

If a natural asphalt is used it must be heated at least to a temperature of 300 deg. Fahr.—usually about 350 deg.—and applied under a pressure of 60 lb. per square inch. The rule of the Massachusetts Highway Commission is to use about 1 gal. of binder to each inch of thickness of the top course. The greatest care is necessary to apply the binder uniformly. With the 2-in. top course used on most of the roads the application of binder has amounted to about 1¾ gal. per square yard of road surface. When the binder has been applied the surface of the roadway is immediately covered with a light layer of pea-stone, just thick enough to prevent the roller from picking up the surface. The pea-stone is broomed and used to fill the voids and is then thoroughly rolled. For this operation the best results are secured with a heavy roller, from 15 to 18 tons. After rolling, the surplus stone is swept off and a second application of binder made to form a seal coat. The seal coat is applied at the rate of about ½ gal. per square yard. The road surface is again covered with pea-stone and thoroughly rolled. This completes the operation of building a pavement by the penetration method.

State Buys Binder

A point worth remembering in connection with the Massachusetts work is that the State Highway Commission purchases a large proportion of the binder material used on its penetration roads and supplies this direct to the contractor, thereby minimizing any uncertainty as to the quality of the material. If the commission does not purchase and supply the binder it pays the contractor a certain price per gallon—not per square yard of pavement. In either case there is no incentive for the contractor to economize on the amount of binder used.

It may be well to emphasize again the importance of the large stone in the top course. The large stone stays in place when rolled, binds itself and does not move under traffic. When the life of the asphalt binder is partly gone the larger stone stays in place and there is no evidence of raveling.

The standard methods of constructing penetration roads were varied last year by introducing the tar-sand method. In this work the procedure is exactly the same as

FINAL STAGES IN TAR-SAND WORK—RIGHT HALF OF ROAD HAS BEEN COVERED WITH PEA-STONE WHILE LEFT HALF HAS NOT YET RECEIVED COVERING has been outlined for the ordinary penetration work until the binder is applied. Instead of using an asphalt applied hot under pressure, equal proportions of sand and tar, mixed at a temperature of about 300 deg. Fahr., are employed. Although the method has not yet been fully developed it gives promise of excellent results. The material is applied to the roadway from an inclined trough, as shown in the photograph at the top of page 609, and is spread out by means of rubber squeegees or brooms, as shown in the photograph below.

Effect of the Sand

The effect of the sand is to retain the heat in the bitumen and by adding to the weight of the mixture allow it to flow completely into the voids. This type of surface treatment has been applied both with and without a seal coat. When a seal coat was used tar was the material employed. After the tar-sand coat is applied the surface is covered with a thin layer of ¾-in. stone, then rolled, and the seal coat put on. The ¾-in stone takes up the surplus tar and gives a uniform surface.

TAR-SAND MIXTURE AND END OF INCLINED DISTRIBUTING TROUGH, SHOWING RUBBER SQUEEGEE FOR SPREADING MATERIAL

The cost of the above described tar-sand method is from 3 to 8 cents per square yard more than for the straight penetration work. It was used in five places in Massachusetts last year, and where the workmanship was good excellent results have followed.

Costs

As a general rule the straight penetration work with a 4-in. base and 2-in. top course, using a lake asphalt binder, costs from $1 to $1.30 per square yard. With other asphalts the cost was less in a degree corresponding to the cost of the binders; and the same may be said of tar as a binder. A tar-bound road costs generally 25 cents per square yard less than a road bound with natural asphalt.

The methods of building roads by the penetration method, described in this article, were developed on work of the Massachusetts Highway Commission, of which Col. William D. Sohier is chairman and Arthur W. Dean, chief engineer. F. C. Pillsbury, engineer in charge of Division 3, directed the work with which this article deals.

Preliminary Estimating of Grading Simplified

General Formula Derived for Correcting Level-Section Areas to Account for Transverse Ground Slopes

By J. MAUGHS BROWN
Professor of Civil Engineering, University of South Dakota, Vermillion, S. Dak.

TO THE READERS of the Engineering Record who, like the writer, have burned holes in the tent roof with a John D. illuminator while trying to get up a passably accurate preliminary estimate to the accompaniment of the howl of the desert coyote, the article on "Preliminary Estimating of Canal Excavation" by Lewis M. Hammond in the Engineering Record of Jan. 30, page 146, was of particular interest.

Every engineer who has cared to turn in a preliminary estimate a little better than usual of quantities on continuous line surveys, whether it was canal, railroad, or pipe-line work, has been confronted with two questions. First, how far will the results obtained from the method of scaling off center cuts and fills and computing quantities by a table of level cuttings be in error in case the line falls on ground with considerable transverse slope? (In railroad work it is customary to mark the quantities directly on a strip of profile paper which is used as a scale.) Second, are the data available and the nature of the results expected such as to warrant a large expenditure for refinements?

Mr. Hammond has answered the first question very well by deriving several formulas for the area of a canal section in ground with a transverse slope. Believing, however, that in general the answer is "No" to the second question, and that the average job does not warrant the time necessary for preparing the tables proposed by Mr. Hammond, the writer proposes to derive a simple formula, using only arithmetic and algebra in its deduction, for the difference between the area of a level section and one having a transverse slope for any cut or fill and any side slope.

Derivation of Formula

Let H = center cut; M, one-half of base; s_1, s_2 and z, slopes of two sides of section and of ground surface respectively, in feet horizontal divided by feet vertical; A_1 and A_2, areas of triangles between horizontal and ground surface, and C, correction to be added to area of level section with equal center cut.

In the case shown in the figure where the slope line GR of the ground cuts above the base point J, we have for the difference in area between the level section AJKC and the slope section RJKG,

$$A_1 - A_2 = C$$

Now

$$A_1 = (\mathrm{BC}/2)y_1 \qquad \text{(a)}$$

and

$$A_2 = (\mathrm{BA}/2)y_2 \qquad \text{(b)}$$

Also, in triangle 1,

$$y_1 z = \mathrm{BC} + x_1 \qquad (1)$$

and

$$y_1 s_1 = x_1 \qquad (2)$$

Subtracting equation 2 from equation 1 and solving for y_1,

$$y_1 = \mathrm{BC}/(z - s_1)$$

Similarly, in triangle 2,

$$y_2 = \mathrm{BA}/(z + s_2)$$

Also, from the figure,

$$\mathrm{BC} = M + Hs_1$$

and

$$\mathrm{BA} = M + Hs_2$$

Substituting the values of y_1, y_2, BC and BA in equations a and b we have

$$A_1 = \frac{\overline{\mathrm{BC}}^2}{2(z - s_1)} = \frac{(M + Hs_1)^2}{2(z - s_1)}$$

and

$$A_2 = \frac{\overline{\mathrm{BA}}^2}{2(z + s_2)} = \frac{(M + Hs_2)^2}{2(z + s_2)}$$

Subtracting,

$$A_1 - A_2 = C$$

$$= \frac{1}{2}\left[\frac{(M + Hs_1)^2}{z - s_1} - \frac{(M + Hs_2)^2}{z + s_2}\right] \qquad \text{(A)}$$

which equation will apply to any section where $Hz > M$.

In case $Hz < M$, there must also be added to this correction the area A_3 of the small triangle 3, which can be found in an exactly similar way.

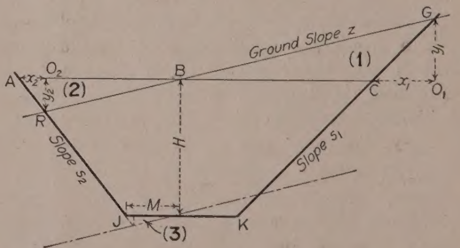
$$A_3 = \frac{(M - Hz)^2}{2(z + s_2)}$$

Adding this to equation A we have

$$C = \frac{1}{2}\left[\frac{(M + Hs_1)^2}{z - s_1} - \frac{(M + Hs_2)^2}{z + s_2} + \frac{(M - Hz)^2}{z + s_2}\right] \qquad \text{(B)}$$

Application

Equation B is the general formula for all cases. This reduces to a very simple form for special cases. If $Hz > M$ the last term drops out and we have equation A. If $Hz < M$ we will have some fill if the center is in cut, and vice versa if the section is nominally in fill. This can be computed by working out the triangular section in a manner exactly similar.



Taking a special case given by Mr. Hammond, a canal section with base = 6.28 ft.

and equal side slopes of 1:1, we have by substituting values in equation A,

$$C = \frac{(H + 3.14)^2}{z^2 - 1}$$

For any section having equal side slopes, *s*, as usually found in railroad sections, equation A reduces to a simple form similar to the above equation. Thus, from equation A,

$$\begin{aligned} C &= \frac{1}{2}\left[\frac{(M + Hs)^2}{z - s} - \frac{(M + Hs)^2}{z + s}\right] \\ &= \frac{1}{2}\left[\frac{(M + Hs)^2(z + s) - (M + Hs)^2(z - s)}{z^2 - s^2}\right] \\ &= \frac{(M + Hs)^2 s}{z^2 - s^2} \qquad \text{(C)} \end{aligned}$$

COMMENTS

Equation C may be worked very rapidly on a slide rule for all points shown on the topography to have a steep side slope, it not being absolutely necessary to have prepared tables or curves. The writer prefers to use a level cutting table, to which is added the correction found above, rather than prepare extensive tables for the areas and quantities of the several slope sections. Areas can easily be reduced to cubic yards per station by multiplying the result found from the above equations for corrections by 3.7. After a few sections have been corrected in this way, one can tell at a glance whether the side slope is sufficient to warrant any correction at all.

In case tables or curves are desired, they can be computed for the correction *C* according to the above forms. In the case of curves, sufficiently accurate results can be taken off very rapidly for the majority of sections likely to occur.

There is considerable time and labor involved in preparing tables such as Mr. Hammond's, and the average job will hardly warrant more than the plotting of a few curves showing the correction to be applied on steep slopes. If more accurate results are desired, very often it would be better to go out and rapidly and roughly cross-section by means of a hand level, after the location has been run in.

Electric Drag-Lines on Little River Drainage Project

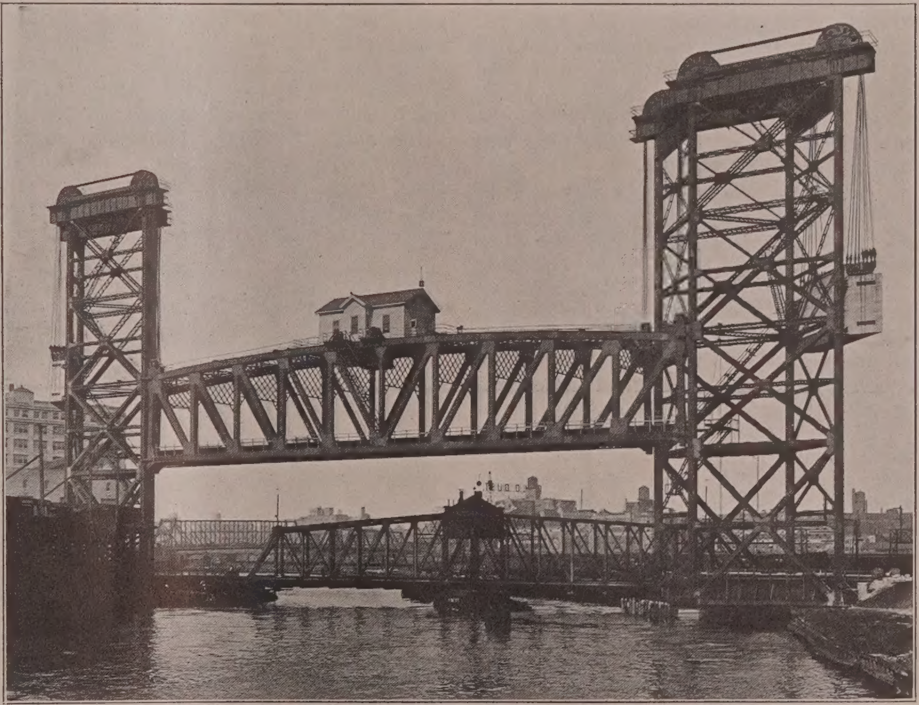
THE use of drag-line excavators on the diversion channel of the Little River Drainage District, in Missouri, was described in the Engineering Record of April 3, 1915, page 429. Since that article was prepared new machines have been ordered and the work is now being done by two electrically-driven drag-line excavators built by the Bucyrus Company, of South Milwaukee, Wis., while two other machines of the same general type are now under order with the same company. One of the machines now in service has a 4½-yd. dipper and a 100-ft. boom, while the other has a 3½-yd. dipper and a 125-ft. boom.

A VAST AMOUNT OF UNDEVELOPED WATER POWER that can be developed without interfering with the use of water for irrigation is to be found in Wyoming, according to J. B. True, State engineer. As a matter of fact, it would eventually aid materially in the reclamation of lands by lifting water to those lands that are too high to be reached by gravity.

Special Conditions Govern Selection of Lift Bridge and Method of Erection

Structure of Pennsylvania Lines Over South Branch of Chicago River Designed for Future Elevation of Tracks and Possible Duplication

THE REPLACEMENT of the old double track swing bridge of the Pennsylvania lines over the south branch of the Chicago River by a structure which would not only permit a future 25-ft. elevation of track but also allow erection of the new bridge to proceed without in any manner restricting either railroad or river traffic has recently been accomplished. The new structure also had to be selected to permit future duplication if necessary to meet increasing traffic requirements. These conditions were met by the selection of a double-track lift bridge, raised by cables running over high towers at each end, and erected by means of a fan-like arrangement of falsework built out from the main towers.



NEW SPAN AFTER ITS COMPLETION AND THE REMOVAL OF FALSEWORK

The falsework was unusually heavy. The outer leg was nearly 147 ft. long and required a cross-section of 1344 sq. in., which was obtained by the use of ten large timbers bolted together. The following details of the design, the difficulties encountered and the methods of erection have been abstracted from papers prepared under the direction of J. C. Bland and presented before the Western Society of Engineers by W. L. Smith and W. W. Triest.

GENERAL DESCRIPTION AND OPERATION

The new bridge consists of a double-track riveted-truss lift span, 272 ft. 10 in. center to center of end posts, with two Pratt trusses with inclined top chords, and a tower at each end. The towers are from 30 ft. 2 in. to 30 ft. 8 in. wide, 53 ft. 6 in. long and about 185 ft. high. The structure is skewed at an angle of 47 1/3 deg. At each end of the bridge is a sectional counterweight consisting of two structural steel frames covered with about 315 cu. yd. of 1:2:4 slag concrete, the approximate weight of each counterweight being 1,582,000 lb. Careful estimate showed that the cost of the counterweight would be substantially the same whether slag or broken stone were used, with possibly a slight difference in favor of broken stone. Rivet plugs were also considered, but were not used because they were difficult to obtain in sufficient quantities, and were quite expensive.

To permit the passage of vessels, the truss span can be raised in 45 sec. from the normal position to the maximum height of 111 ft. The span and its counterweights are suspended by sixty-four 2¼-in. plow-steel ropes over eight 15-ft. sheaves of structural and cast steel. Sixteen 2¼-in. ropes connected to the top chord at each end of each truss pass over a pair of sheaves and are attached, by means of equalizing devices to the counterweights.

The span is operated by two 300-hp motors, geared to four cast-steel operating drums, each of which carries four 1⅛-in plow-steel operating ropes. These ropes pass over deflection sheaves at the ends of the span—two going up and two going down at each corner—and are fastened to the top and bottom, respectively, of the towers. Either motor alone can operate the driving mechanism. A 50-hp gasoline engine will be installed for emergency service. This engine will lift the span to its maximum height in about 10 min. Limit switches cut off the current when the span has reached its limiting position, and solenoid brakes are applied automatically. Hand brakes are provided as an additional safeguard.

By far the most serious trouble, and the most expensive as well, has developed in connection with the sheaves. Owing to their size—15-ft. pitch diameter—they are of built-up construction, i.e., each sheave consists of a center steel casting or sleeve and seven sections of cast-steel rim segments, the rim and sleeve castings being connected with a web of built-up riveted-steel construction. The detailed drawing for the sheaves called for "all contact surfaces between rim segments, between web plates and rim, and between web plates and sleeves to be finished to accurate bearing over entire area." The sheaves as manufactured, however, did not meet this requirement. To insure proper action between the rims and webs, four splice plates were added to each connection between the web diaphragms and rims, this affording eight additional turned bolts in double shear at each of these points. To prevent creeping of the built-up portions of the sleeves, four plans were considered, and the method adopted was to drill holes for 1-in. pins on line between center castings and hub and drive tight-fitting pins into them. The cost of adding the splice plates was about $390 per sheave or $3100 for the bridge; the cost of adding the pins was about $3500 for the bridge.

Operation of the rail locks was difficult at times owing to the failure of the span to seat itself each time in exactly the same position. This was remedied by attaching entering tongues to the end floorbeams of the truss span. These entering tongues engage centering guides which are carried by the floorbeams at the span ends of the towers. As originally designed the operating cables were supported on the center line of the curved top chord by gumwood rollers mounted in steel brackets. These rollers wore rapidly and in some cases failed to turn. The ropes, when slack, abraded each other and the top chords of the trusses. To overcome this excessive wear on the rollers and to remedy the other conditions above described, deflection sheaves were mounted on the upper chords at each end of each truss.

Deficiencies in the Design

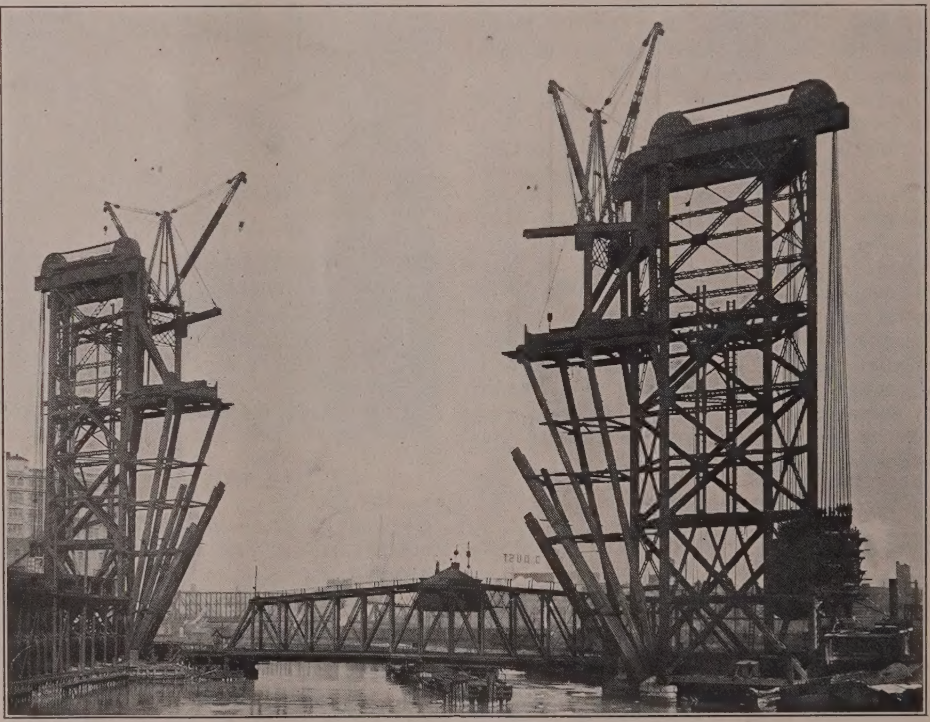
In constructing another bridge of this type there would also be provided a device whereby there would be no unbalanced load from the counterweight ropes. The lift span as designed is supposed to be perfectly balanced when at midheight only. At all other points of its travel there is an unbalanced effect from these ropes. This unbalanced condition is plainly a maximum amount when the lift span is at the extreme limit of its travel. When beginning to lift the span from its normal position, therefore, besides overcoming frictional resistances from the weight of the moving span, counterweights, etc., there must also be overcome this maximum unbalanced condition.

Provision should be made for cutting off the power when the operating cables break at either end of the span. As designed, there is nothing to prevent the operator from continuing to hoist the span after the operating ropes break at either end. If the span is not properly counterbalanced, it can be seen that the end of the span where the breakage occurred might, under certain conditions, be pulled down.

Governing Conditions

It is expected that the tracks will be raised from 20 to 25 ft. at this point in the future. This type of bridge is particularly well adapted to making such a change. The tower bracing has been so arranged that when this track elevation is attained the present lower transverse struts can be replaced with the present tower floorbeams. All that then remains to be done to the superstructure before putting it in service is to place the supporting columns under the corners of the lift span and raise the tower floor system and the approach girder spans to their new positions and rivet them up. It will be noted that the entire truss span is raised to bring the track to the new grade—not the floor system alone. This means that not only is the expense and delay incidental to disconnecting the floor system and riveting it up again in its new position avoided, but the underclearance is increased so as to permit the passage of many small boats which would otherwise require operation of the bridge.

Among other considerations which influenced the selection of this type, its estimated cost was less than that of the three other types of movable bridges under consideration. Furthermore, as the operating machinery is very simple and direct in its action and as the wire rope should not, with proper care, require renewal for a long time, the cost of maintenance would be very low, indeed much lower than that of many other types. Sufficient clearance was provided throughout for the construction of a second bridge of this type at a minimum distance from the present bridge of 35 ft. 6 in. center to center.



FRAMES IN END POSITIONS ON LIFT SPAN, ERECTING SPAN AND FALSEWORK

Details and Sections

At both ends of the lift span centering castings on the trusses engage corresponding centering castings on the tower columns. At the fixed end a small clearance is provided; at the other (expansion) end ample clearance is provided for the longitudinal expansion and contraction of the span. The shoes consist of massive cellular cast-steel blocks with vertical lips (two each) which project above their top surfaces and engage the vertical sides of the truss pedestals, which are pin-connected to the trusses. At the expansion end their bearing surfaces are curved, affording ordinary rocker action for the truss span under expansion and contraction.

An expansion joint is provided in the floor system at the connection of the stringers to the floorbeam near the center of the span. Train-thrust frames, to prevent lateral bending in the floorbeams, are provided at about one-quarter span length from each end of the truss span to carry the horizontal loads (from braking trains, etc.) directly into the trusses.

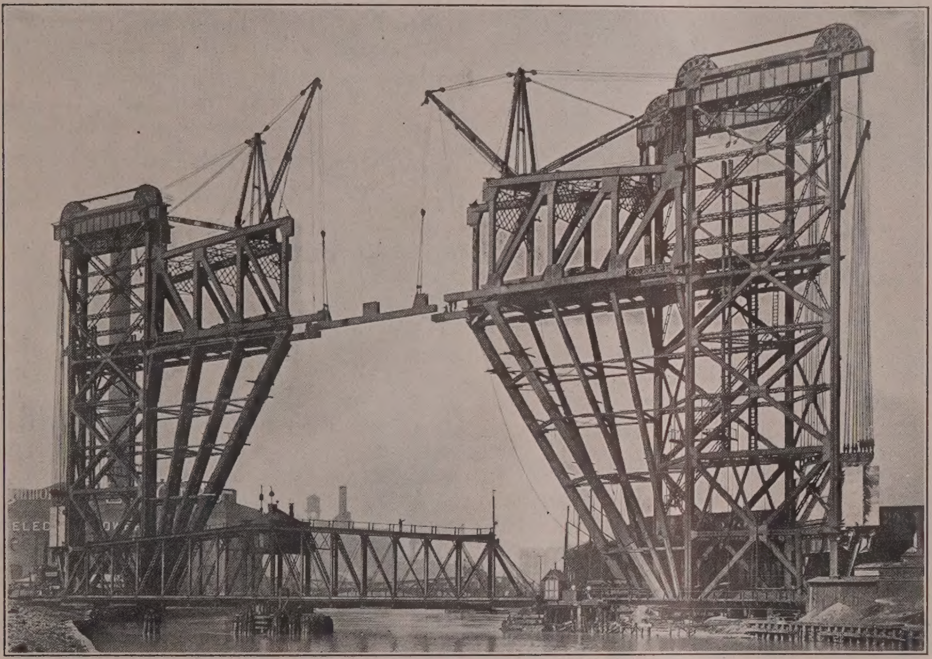
The top chord members of the lift bridge are of the usual type of construction, consisting of two built-up channels connected with a cover plate. All web and bottom-chord members consist of two built-up channels with flanges turned inside, connected with lacing. The largest top chord has a section of about 240 sq. in., the largest bottom chord a section of 226 sq. in. The tower columns are composed of built-up H-sections consisting of eight angles and three web plates. The lower portions have a cross-section of about 216 sq. in., are 80 ft. long and weigh about 40 tons each.

Loading and Specifications

For the trusses, in addition to the dead load of 9740 lb. per linear foot for the double-track truss span, a uniform live load of 5500 lb. per foot plus a concentration of 66,000 lb. per track is assumed. The floor-system connections are designed for a concentrated live load of 99,000 lb. per track. The wind loads are 150 lb. per foot of span for upper laterals and 500 lb. for lower laterals. Of the latter 300 lb. is considered as moving load. For the towers, the wind load is assumed as 30 lb. per square foot with span down, and 15 lb. with span up, in each case reduced by Duchemin's formula. The tower columns were designed for both present and future loading according to certain specified combinations.

The specifications for railway bridges, Pennsylvania Lines West of Pittsburgh, dated April, 1906, were used for the design and manufacture of the structural steelwork except that (1) the allowable unit stresses were increased 15 per cent for all members carrying loads from two tracks at the same time; (2) those in the tower columns were increased one-third when wind loads were included, and (3) those in the tower and traction bracing were 12,000 lb. per square inch for tension, 12,000 — 44l/r lb. per square inch for compression, and 9000 lb. per square inch in the truss laterals.

The operating ropes were designed in accordance with the following clause: "The ratio of the total stress (including bending) to the elastic limit shall not exceed 75 per cent; the ratio of ultimate to direct stress shall not be less than 4½." In explanation of what may seem an excessively high ratio of total stress to elastic limit, it may be added that the consulting engineers considered this ratio a proper one because while bridge steel is ordinarily stretched to about one-half its elastic limit, impact included, it is less thoroughly worked in its manufacture and is less uniformly reliable than the material entering into the construction of wire rope.



A-FRAMES IN FINAL POSITION—TOWER CHORD BEING SWUNG INTO PLACE

CONDITIONS GOVERNING ERECTION

In deciding on the method for erecting the new bridge, two important points had to be kept in mind: (a) That no interference with navigation would be permitted, and (b) that it was necessary to maintain the railroad traffic on the old swing span up to the time it was transferred to the new bridge. Therefore the latter would have to be erected so as to permit the operation of the old span, and also so the transfer of the railroad traffic to the new bridge could be made in the shortest possible time, bearing in mind that the old span would have to be removed before the new span could be put in position for traffic.

Two methods to take care of these conditions were considered, one of which entailed the erection of the lift span on falsework parallel with and close to the dock line at some point on the river, and afterward floating it into its permanent position on barges. The other method contemplated erecting the span in its permanent position on falsework high enough to clear river navigation. The latter was adopted because it seemed to offer less chance of delay to navigation and a better opportunity to transfer the railroad traffic quickly from the old to the new bridge.

The tower columns were erected in three sections, the bottom section being about 81 ft., the middle 47 ft., and the top 57¼ ft. long. After setting the bottom sections of the columns by a derrick car, the bracing for these sections was bolted in place and a derrick specially designed for completing the erection of the tower was set up on the part of the tower erected. In order to erect these towers within a reasonable time it was necessary to provide a derrick that would handle a load of about 30 tons at a 44-ft. radius, and could be shifted from point to point easily and quickly. The design adopted called for a derrick with a timber A-frame and two booms set up on a combination wood and steel beam which was secured to vertical timbers bolted to two sides of the tower, these timbers being extended as the erection of the tower progressed.

FALSEWORK FOR TRUSS SPAN BUILT IN A FAN SHAPE

In order to clear the river navigation, the falsework for the lift span was built in a fan shape and could only extend from the towers to the third panel point from each end of the span, leaving a gap of 108 ft. under which no falsework could be placed. This falsework consisted of three main legs under each end of each truss, arranged as are the sticks in a fan, the lower ends of all legs being set close together on the concrete foundation built on the masonry at the foot of the inner columns in the towers. Their upper ends were secured to the towers by means of eyebars and plates, and were all thoroughly braced at properly spaced intermediate points.

The inner and center legs of the span consisted of four 10 x 12-in. timbers bolted together, and the outer leg of four 10 x 12-in. and six 12 x 12-in. timbers bolted together, making a sectional area of 1344 sq. in. This outer leg was nearly 147 ft. long on its center line and was built to sustain a load of 360 tons applied at its upper end.

ERECTION BY A-FRAME DERRICK

The method of erecting the lift span by the use of the A-frame derrick is indicated in the accompanying progress photographs. The gap of 108 ft. between the ends of the falsework supports was cut down to 73½ ft. by the projecting ends of the bottom-chord sections already in place, and was closed by connecting the bottom chord with a center section 73½ ft. long, which was swung into position by the two A-derricks as shown. This center section weighs about 36 tons. The erection of the trusses was then completed and the remaining four panels of floor system, lateral and sway systems put in place. The span was erected at a clear height of 130 ft. above low water.

During the erection of the span the counterweight frames were erected and the concrete forming the counterweights poured. They were supported by steel brackets attached to the foot of the columns until the lift span was ready for trial operation. As soon as the erection of the lift span was completed, the machinery house was erected, the machinery was installed, and the floor deck and tracks were put in place. The falsework under the lift span was not removed until the span was loaded with practically all the weight it would carry when completed ready for traffic.

Three schemes were considered for removing the old swing span. The method finally adopted consisted in floating two scows partly loaded with water under the north end of the span, blocking up on the scows under each panel point of this end of the span, cutting the span in two at a point near the north side of the pivot pier with an acetylene flame, and floating the north end out of the way. When this was done the end of the span resting on the pivot pier was jacked east about 4 ft. so as to clear the new span, and left in this position until dismantled.

When the new span was finally lowered into position on the bridge seat it was found that the line and surface of the tracks on the span required some adjustment, and also that the operating ropes required adjustment properly to land the span. It was 21 hours 10 min. from the abandonment of traffic on the old swing span to its restoration on the new lift span. From the time of beginning the erection of the towers to the time the structures were put in service ten months and twenty-six days elapsed.

Waddell & Harrington, of Kansas City, Mo., were the consulting engineers for this work. They prepared the stress sheets, general detailed drawings and special specifications for the mechanical and electrical equipment under the general direction of J. C. Bland, engineer of bridges, Pennsylvania Lines West of Pittsburgh. The bridge was fabricated and erected by the Pennsylvania Steel Company, Steelton, Pa. It was completed and put in service last year at an approximate cost of $750,000.

HYDROELECTRIC PLANTS IN NEW ENGLAND are producing more than 2,000,000,000 kw-hr. of energy, which, if produced by coal, would mean the annual consumption of 3,000,000 tons of that fuel, according to figures given by Henry I. Harriman, president of the Connecticut River Power Company, in an article in the General Electric Review.

How Cleveland Fixes Sizes of Courts and Yards

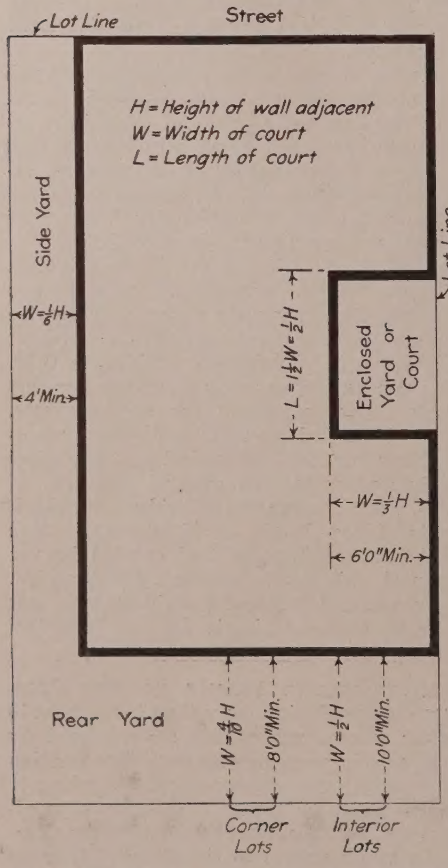
V. D. Allen, Building Commissioner, Injects Into City's Housing Code First Scientific Method for Designing Areaways

IN REVISING Cleveland's housing code dealing with tenants, V. D. Allen, commissioner of buildings, decided that the almost universal method of determining the size of courts and yards for tenants by the number of stories in the building and by the length or depth of lot was not what it should be. It is perfectly obvious, contended Mr. Allen, that it is the height of a wall which casts a shadow and not the number of subdivisions back of the wall, and as a result it is immaterial whether a wall which is 100 ft. high is divided into one or twenty stories—it casts exactly the same shadow along its outside.

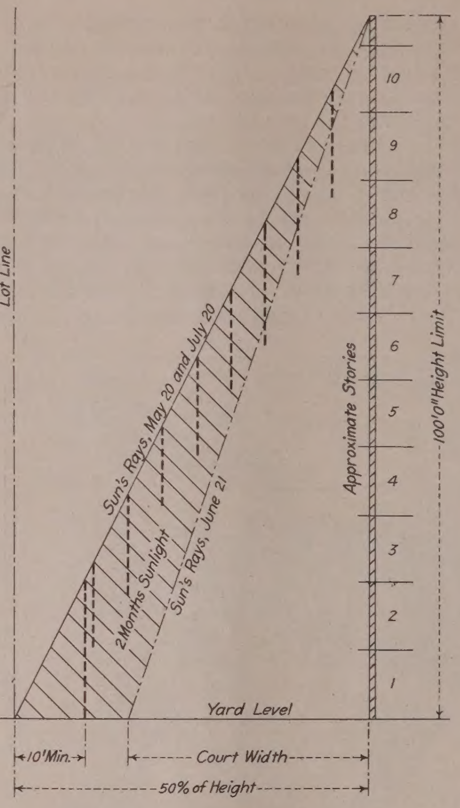
In determining the size of yards the three considerations taken into account are light, ventilation and fire protection. As long as one does not provide light or ventilation, that is, openings in the wall, there is no fire hazard from the outside. Therefore, the fire risk is incidental to the question of light and ventilation. Of the two features—light and ventilation—Mr. Allen was convinced that light was the determining factor.

CALLS SUN INTO SERVICE

He found that in the latitude of Cleveland the sun is 71 deg. above the horizon at noon June 21 and he figured that the sun's direct rays should reach the bottom of any court or yard at the far side of such opening at least 1 min. each year. Mr. Allen, therefore, decided to make the width of the courts a function of the height of the wall; that function to be the tangent of the angle between the sun's rays on June 21 and the vertical, or 19 deg. This tangent is 0.34. Afterward this was slightly modified to make the function exactly one-third of the height of the wall, which is so small a variation from the true angle as to be negligible. The length of a court was arbitrarily placed at one and one-half times its width, which works out to be one-half the height of the wall. This covers all courts and yards surrounded or partly surrounded by walls of the building.



LIMITING SIZES OF YARDS AND COURTS



SLOPE OF SUN'S RAYS FIXES LIMITS

Where a passageway is provided at the side of a building, from the front to the yard in the rear, it is made one-half the width of the court and yard as above determined, on the ground that while sunlight is lost a free circulation of air through the passageway is obtained, it being open front and rear. This makes yards at the side of a building one-sixth the height of the adjoining wall. The accompanying plan shows the various dimensions.

In the rear of all tenements is to be provided a yard which shall measure backward from the building a distance equal to one-half the height of the wall. This allows the direct rays of the sun to fall on the yard for two months of the year. In the case of a corner lot where the building has light and ventilation from two sides, the rear yard may be cut down to four-tenths of the height of the wall, on the ground that buildings so located already have a large increase in light and ventilation as compared with buildings on interior lots.

NEW RULES ARE SIMPLE

These rules are believed to be the simplest yet proposed and to give every advantage to the designer who is careful in the arrangement of his building, both vertically and horizontally, on his lot. The theory, with modified angles, will apply to all cities, irrespective of their latitude, since if they are further north, where they get less sunlight, their courts and yards will be wider, and if further south, where they have plenty of sunlight, the courts and yards may be correspondingly reduced.

In the new Cleveland rules all references to the size of lot or number of stories in the building have been eliminated. An irreducible minimum has been used for the width of courts and yards. Where the width is one-third the height of the wall the minimum is 6 ft., which is about the equivalent to that required for a two-story building. Where a width of one-sixth of the height of the wall is required the minimum is 4 ft., which is as small a passageway as would be useful for firemen in passing from front to rear with their ladders and other fire-fighting apparatus. The minimum width of the rear yards on interior lots is 10 ft., while the same dimensions for yards on corner lots is 8 ft.

Complete New Track Entirely Before Putting It in Service

By J. T. BOWSER

Maintenance-of-Way Department, Queen & Crescent Route, Danville, Ky.

PUTTING new railroad tracks, such as additional mains, into service just as soon as they are safe for operation often proves to be a false economy; and closing the construction accounts before all work properly chargeable to the construction is completed throws an unfair burden on maintenance costs.

A few weeks, or often a few days, additional time will probably enable the construction forces to complete work, which, while perhaps not apparent to the operating official, will nevertheless cause considerable loss and additional expense if not done before the new track is thrown open to traffic. In cases where the roadbed is constructed of certain kinds of material, irreparable damage is done by permitting the continuous use of the track, even by work trains, before ballast is applied, or even after only a light ballasting has been effected. In such cases the ties will seat themselves in the roadbed, forming water pockets which will probably constitute a permanent cause of trouble. Tracks put into service before a permanent surface on heavy ballast has been completed are liable to costly injury through bent rails, battered joints or broken ties.

Even after the new track has been opened to regular traffic for some time, in no case should the work be considered completed until a final raise has been made and the necessary ballast placed to bring the track up to its permanent cross-section. If the track is to be properly maintained, such a raise will very probably be necessary, and the cost of this should be considered a proper charge to the construction account, and not left unjustly to increase maintenance costs.

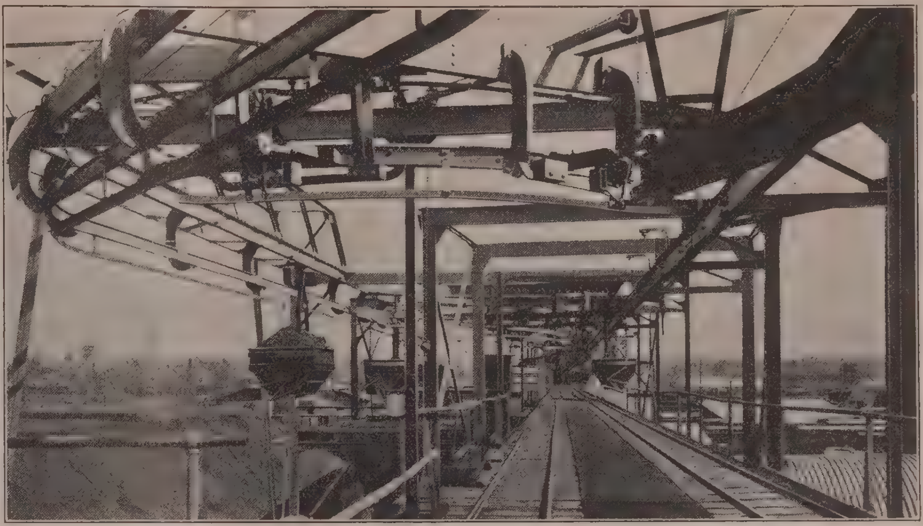
UNPRECEDENTED DEMAND FOR HIGH-SPEED STEEL is reported by Consul John M. Savage at Sheffield, England. Nothing approaching the present demand has heretofore been experienced; orders are not only numerous but they are of tremendous size and value. In addition to British sources, orders come from Russia, France, Italy and the United States. The price varies today from 4 to 97 cents per lb. An immense quantity of tool steel is being used in the production of armaments, and every engineering shop in England is busy on this work.

Telphers Expedite Coal Movement at German Plant

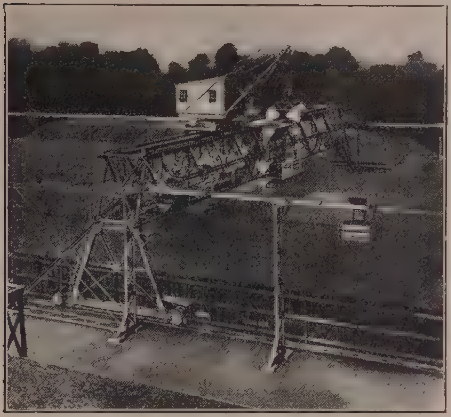
Automatic System, with Traveling Bridge, Bucket Elevator and Two Cranes, Joins River, Railway, Boiler House and Storage Yard

By DR. ALFRED GRADENWITZ
Berlin, Germany

A FLEXIBLE telpher system for the transport of coal is in use at the municipal electric plant at Frankfort-on-Main, Germany. A number of railroad tracks lie between the plant and the river. By means of the telpher system, which crosses the railroad yard on a track 590 ft. long, supplemented by a traveling bridge spanning a coal storage yard 335 ft. long and 130 ft. wide, coal can be conveyed (1) from the river side to the boiler house; (2) from railway cars to the boiler house; (3) from cars to the storage yard; (4) from cars to the yard, and (5) from the yard to the boiler house. The automatic service at the storage yard, at such a considerable distance from the river, is one of the most remarkable features of the plant.



TELPHER LINE SWINGS OUT AT BOILER HOUSE TO PERMIT UNLOADING



TRAVELING BRIDGE FORMS TELPHER LINK AT STORAGE YARD

Telphers

One of the views shows the elevated track between the river and the power house. At the waterfront a slewing crane with grab bucket unloads the barges and dumps the coal into a hopper on the elevated track. A bucket elevator handles the coal that arrives by rail, emptying it into another hopper as shown in the foreground of the picture. From either of these hoppers the telpher cars are loaded by opening the closing trap.

Another view shows the two telpher tracks at close range, at the point where the coal is transferred to the bucket conveyor serving the boiler-house bunkers. Loaded cars run on one of the tracks and empties on the other, always in the same direction, a patented block system automatically keeping them uniformly spaced. At the point shown in the picture the "load" track turns out and passes over a hopper, and as the telpher cars pass over the hopper a dog strikes and automatically opens the bottom flaps, emptying the cars while in motion. The cars then pass around a loop and return to the river.

Traveling Bridge

When it is desired to empty the coal in the storage yard the telpher is switched to a track along one side of the yard. When it reaches the traveling bridge it is again switched to a rail suspended therefrom, and emptied wherever desired by means of a movable automatic release arrangement. The car then returns via another track along the opposite side of the yard, which also connects with the traveling bridge.

A traveling slewing crane is provided on the bridge to rehandle the coal. This takes the coal up in a grab bucket and deposits it in a hopper in the center of the bridge, under which the telpher runs. The telpher with its load runs to the boiler-house hopper, and immediately loops back empty.

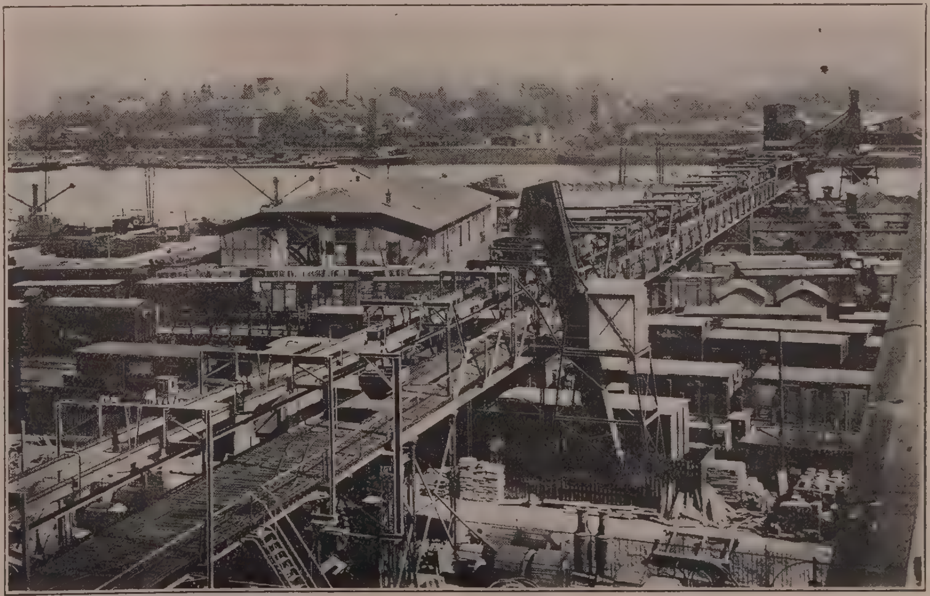
Control

For controlling the service, in transferring coal from barges or from the storage yard to the boiler house, one man only, in addition to the crane operator, is required. It is his duty to stop the cars at the loading point by means of a switch, and after opening the closing traps of the hopper again set the switch for traveling, whereupon the next car moves on automatically. The cars traverse the whole track, without any supervision, at an automatically controlled speed and without getting into too close proximity to one another. Derailments or collisions at the switches are also automatically prevented by a patented arrangement, and the discharge over the hopper of the bucket conveyor or in the storage yard is likewise effected with absolute certainty and without any supervision.

In controlling the distribution of material in the storage yard, it is only necessary to shift the release device on the bridge from time to time, in accordance with the progress made with the work. The contents of the cars and the working speeds are so designed that an output of 60 tons of coal per hour can be reached with safety between the extreme points of the plant.

The plant was installed by Adolf Bleichert, of Leipzig, Germany.

GAGE GLASSES showing water levels at the Cobb's Hill Reservoir, Rochester, N. Y., are made more easily readable by providing two black stripes ¼ in. wide and ¼ in. apart on the back of the tubes. The refraction of the light passing through the water column causes the bands to appear wider than they actually are and thus indicates very plainly the exact water level. In fact, the relative positions of the levels can easily be seen across the 20-ft. room of the gatehouse.



CRANE AT RIVER AND BUCKET ELEVATOR AT RAILROAD LOAD TELPHERS

Every Type of Subway Construction but Air Tunnel Used on Harlem River Section

Steel Tunnel Sections, Open Cofferdam, Decked Street Work, Open Shield Tunnels and Pneumatic Shoring Cylinders on Lexington Avenue Route, New York City

PROBABLY the most diversified subway contract in New York, covering section 14 of the Lexington Avenue subway, is nearing completion. Picking up five tracks on two levels at 129th Street, this section brings them to four tubes at one level and takes them under the Harlem River in a steel-concrete tunnel sunk in five sections in a dredged channel, as described in the Engineering Record of 1913, in the issues of Sept. 6 ("Current News Section"), Sept. 13, Oct. 4 and Oct. 11. The subway then separates into an east branch and a west branch, the latter of which passes under the New York Central main-line tracks in a tunnel constructed by an unusual roof shield method, and enlarges from two to three tracks. The roof of the crossover section, which is under private property, and therefore designed to carry a twenty-story building, spans the three tracks on heavy plate-girders weighing as high as 17 tons apiece, and spaced on 30-in. centers. The east branch proceeds in open cut to Mott Avenue. Thus the section includes decked street work, river tunnels, shield-driven tunnels and open cut, with unusual construction problems at every turn.

CONSTRUCTION PROBLEMS

There were more than 470,000 cu. yd. of earth and rock excavation to be handled, and more than 100,000 yd. of concrete to be placed. The job, however, offered a number of points for simultaneous attack, a matter of admittedly great importance in doing work fast and economically. Also, the layout of the sections was favorable for disposal and backfilling.

To open up a job this size at several points at once, however, requires a large amount of plant. A small point will well illustrate this. The contractor has been able to use the same derrick in two locations only in one or two instances. When the work was ready for a derrick at a new point, all those in use still had plenty of work ahead of them, and a new derrick had to be supplied. The work required simultaneous use of one floating and two land mixing plants, the former described in the articles mentioned above.

WORK OPENED IN THREE PLACES

In November, 1912, excavation was begun under Lexington Avenue on the Manhattan side. The following April the open cut for the four-track section and the east branch on the Bronx shore was opened up in one piece. In each instance a space of 125 ft. was left between the end of the river tubes and the open cut, where construction could not go forward until these tubes were sunk. Meanwhile the first of the steel river sections was building, and dredging for them was begun in the channel in March, 1913. This work was far enough along to permit a start on sinking and concreting the tunnel sections in August, 1913. The unexpected finding of a ledge, making necessary double the rock excavation expected, in dredging for the third tunnel section, held up the excavation until winter, and practically postponed the placing of the remaining tunnel sections until the following spring. By the end of September, 1914, however, all tunnel sections were in place and concreted, and by the middle of the following December four sections, counting from the Bronx end, had been completely lined with reinforced concrete. Meanwhile, in April, 1914, the four-track open cut on the Bronx end had been excavated, and construction had been begun on the shield tunnels for the west branch under the New York Central tracks. In September of the same year the section of open cut beyond these tunnels, in which the west branch increases to three tracks, was opened up.

There remained only the 125-ft. spaces at each end of the river tubes, left to protect the open cuts during construction. The one on the north shore was started in June, 1914, and that on the Manhattan end in January of this year.

PLANT

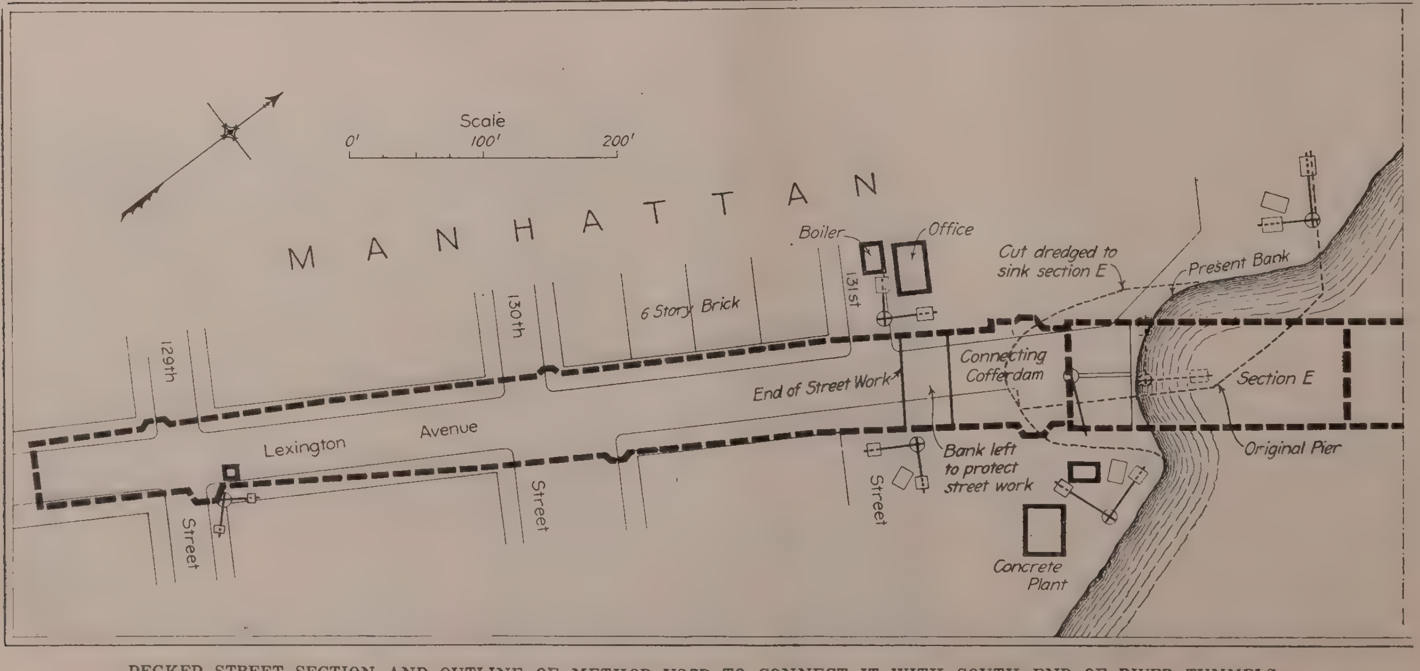
The equipment on the Manhattan end consisted of shaft hoists at 131st Street, a mixing plant fed from barges by a derrick and grab bucket, locomotive boilers totaling 150 hp and three derricks around the excavation joining the river tubes and the Lexington Avenue work. An additional shaft was in service at 129th Street during rock excavation on the Lexington Avenue section, to increase the speed of that work. Compressed air for drilling in this section was supplied from the plant on section 13. Three hoisting engines were used below ground on this rock excavation. One at each working face handled large stones, and the third, located under 131st Street, pulled the cars carrying loaded skips to the shaft.

The yard and docks for building and launching the steel river tubes were located on the Bronx shore a mile from the crossing site. They were served by two stiffleg derricks and a locomotive crane. A boiler and compressor plant of 420 cu. ft. capacity was also located here.

The river plant included two derrick boats, a completely equipped drill boat, a clamshell dredge, a dipper dredge and a floating tremie mixing plant for placing the outside concrete around the river tubes. On this floating plant was mounted a stiffleg clamshell derrick.

On the Bronx shore are placed locomotive boilers totaling 400 hp, a two-stage 1150-ft. compressor, a machine shop and a blacksmith shop equipped with a pneumatic drill sharpener and a steam hammer. The mixing plant for this part of the work is similar to that located on the Manhattan shore. A steel yard, served by a locomotive crane, is situated just upstream from the New York Central tracks, and it, the mixing plant and the excavation are served by a narrow-gage dinky operating over about 1000 ft. of track. The location of the derricks is shown on the accompanying layout drawing.

The section between 129th Street and 131st Street, Manhattan, is one of the deepest and most heavily timbered sections in the new subways. This excavation, which is about 25 per cent rock, was the first



DECKED STREET SECTION AND OUTLINE OF METHOD USED TO CONNECT IT WITH SOUTH END OF RIVER TUNNELS

PLACING TIMBER BULKHEAD IN STEEL FRAME AT SOUTH END OF RIVER SECTION, AND OPEN CUT FOR EAST BRANCH

work undertaken. Much of the material had to be wasted, as there was no place to store it for backfill. It was dumped from the 1-yd. skips used below ground into 4-yd. skips set on platform cars which ran down grade to the river front. A derrick located on the dock dumped these skips into scows. The empties were pulled back to the shaft by a line from the third drum of the shaft hoist. The rock taken out of the 129th Street shaft was hauled away by team.

STEEL SHEETING SEALED TO ROCK

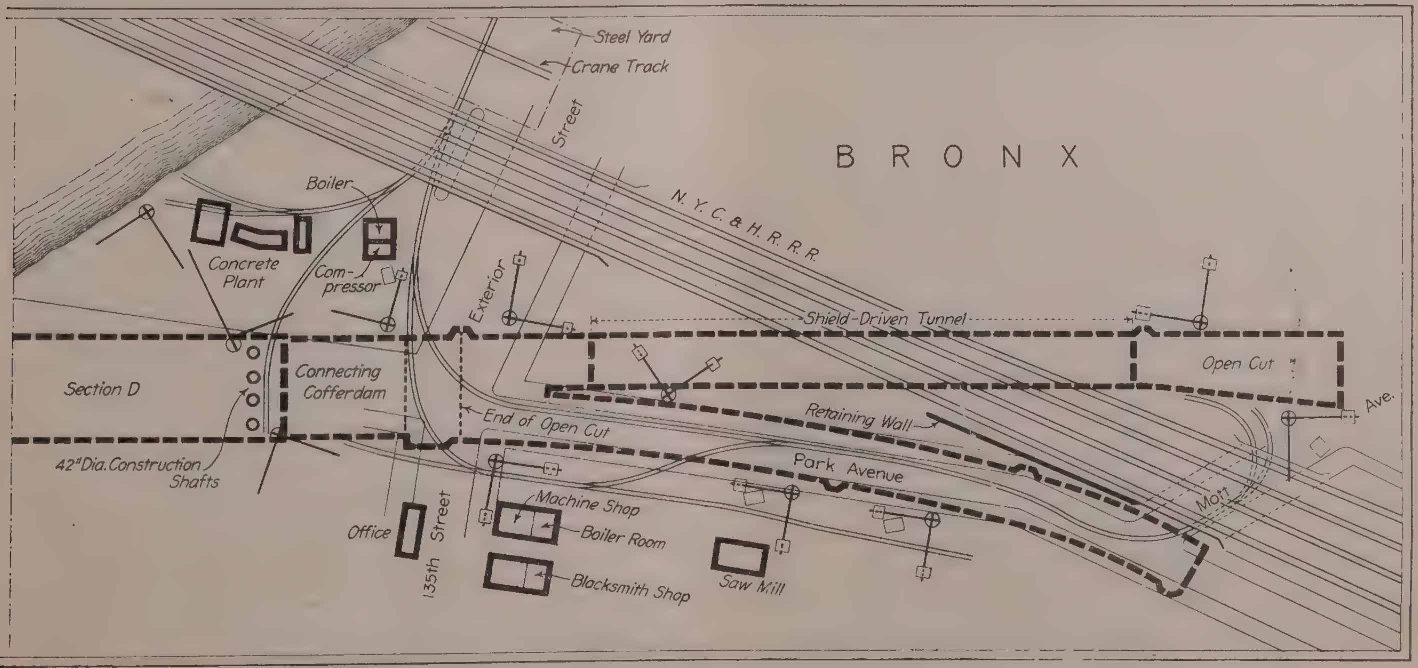
Arch-web steel sheeting about 50 ft. long protected the excavation down to rock. This sheeting was driven in spliced lengths by a driver moving sideways down each sidewalk on Lexington Avenue. A troublesome feature of the work was driving down the sheeting at the river end of this cut and sealing it to rock. This work was hampered by hardpan and a scattering of large boulders immediately above the rock, which had to be either removed or split to allow driving the sheeting down. Workmen underground cut away the hardpan from the foot of each pile as the crew on top drove it down. Most of this piling was dug to rock rather than driven. Bags of sand were kept handy in case of a run, and were required more than once. In many places the irregularity of the rock required a concrete seal at the foot of the sheeting.

These precautions, however, were not relied on to protect the six-story brick building on the west side of the avenue between 130th and 131st Streets. The footings under this building were very shallow, and had to be underpinned with nine 42-in. shoring cylinders, sunk as caissons 40 ft. to rock.

In excavating below the sheeting into rock, a row of vertical line holes on 3 or 4-in. centers was drilled next to the sheeting. The holes for the main charge were drilled and loaded in the usual way. A half stick of dynamite was put in some of the line holes, and all were fired at once. In this way a clean break was made in a vertical line with the sheeting, and no trouble has been experienced from breaking out material beneath the sheeting.

CONNECTION TO RIVER TUBES

On the south end an open cofferdam connects the street section with the tubes. A bulkhead, the frame for which was carried on the shore end of the south tunnel section, formed the river side of this coffer. Its construction and the two corner sections of steel sheeting riveted to each end of it to join the driven sheeting are clearly shown in one of the accompanying photographs. After the tunnel section was in place and concreted, timber was slipped into the bulkhead frame and sheeting started from each side to complete the coffer. The timber bracing for this coffer, like that for the other open sections, was spaced 10 ft. horizontally in each direction and from 5 to 6 ft. vertically. A hole had been dredged over part of the area of this cofferdam in sinking the river tubes. It was thought desirable to place a heavy bank of dirt around the river side of this cofferdam without filling in this hole. Accordingly, a section of bracing extending the full width of the coffer and from the bulkhead to the back edge of the dredged hole, six layers deep next the river and two layers deep at the south end, was built and sunk in place. This bracing held without difficulty the weight of the backfill placed around the cofferdam. The hole was un-watered with a 6-in. pump, and excavation was begun early

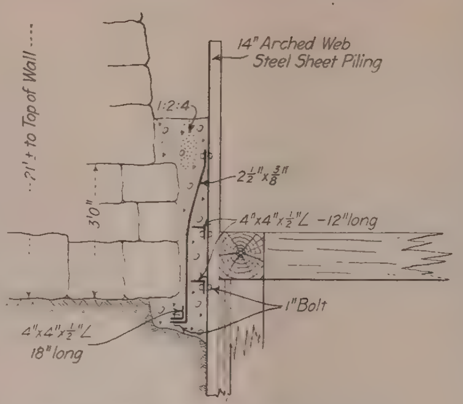


TRACK AND DERRICK LAYOUT HANDLES STEEL, CONCRETE AND SPOIL FOR DIVERSIFIED WORK ON NORTH SHORE this year. On the south side, next the steel sheeting forming the north wall of the street excavation, a bank has been left, which was cut down on its north face in wood-sheeted steps. This bank will be the last dirt taken out, and the junction between the street section and the section in the open coffer will be made after the junction between the coffer section and the tunnel has been finished, to avoid all danger of flooding the street section through a failure on the river bank. Dirt taken from this section is being backfilled on work completed above 129th Street.

RIVER SECTIONS

The five tube sections have all been sunk and concreted. Dredging for them involved 3000 cu. yd. of rock cut, the bottom of which was 57 ft. below low tide. The dipper stick on the dredge which made this cut was a single piece of fir 3 ft. square and 80 ft. long. The work of lining the four north tunnel sections was done from four shafts, bolted on to the north end of each tube in the north section. After the tunnels are finished, a steel plate will be riveted over the bottom of each shaft, and the lower 4 ft. of each will be plugged with concrete. These shafts will then be unbolted at a joint 4 ft. above the steel shell of the tunnel roof, and removed. The south section of the tunnels will be lined from the cofferdam on the Manhattan shore. The character of the lining is shown in one of the accompanying photographs.

As will be recalled from the articles referred to in the first paragraph, these river sections were fastened in line by heavy steel pins in one section pulled through sockets in the adjoining section, and were bolted to each other by divers through angle rings on the end of each section. Both ends of the first section sunk, and the free end of each of the other four, were set to line and grade by putting an instrument on steel masts projecting above water from the corners of each section. The joints between the sections of tunnel proved very tight. Z-bars were riveted inside the tubes at each end of each section, and a circle of steel plates, riveted to these bars before placing the concrete lining, covered each joint and made a continuous steel lining from end to end of the tunnel section.


14" Arched Web Steel Sheet Piling
21' ± to Top of Wall
1:2:4
$2\frac{1}{2}$"x$\frac{3}{8}$"
3'0"
4"x4"x$\frac{1}{2}$"∠ -12" long
1" Bolt
4"x4"x$\frac{1}{2}$"∠
18" long

NEW YORK CENTRAL RETAINING WALL SUPPORTED FROM SHEETING

The toe of the wall was undermined in short sections, after which a set of angles and straps were bolted to the sheeting in each section and concreted in before undermining adjacent sections.

The dirt dredged from the trench for these tubes was taken to sea in dump scows. As the top of the tubes was well below the river bed, there was a considerable volume available for backfilling with material excavated from the north-shore trench work.

NORTH CONNECTING COFFERDAM

The cofferdam joining the north end of the tubes with the open cut was handled much as the similar coffer on the south end is now being worked. Driving the steel sheeting here demanded the same care required on the Manhattan shore. The core between this coffer and the open cut is now being excavated, and the sections will soon be connected. The shore-end bulkheads have been left in the tubes, meanwhile, as a precaution against flooding. The four-track section of open cut first started on the north shore is also practically completed.

EAST BRANCH

The east branch, starting from this point, was finished before these connections were made, the spoil being partly dumped in the river trench and around the ends of the tubes, and partly stored on a vacant lot east of the cut for backfill. The open cut for the east branch itself has now been backfilled. Part of this material was hauled by the dinky from the open cut section of the west branch.

Underpinning the retaining wall along the New York Central Railroad was an interesting feature of the work on this east branch. The load from this wall was transferred to steel sheeting driven on the west side of the cut by means of angles riveted to the back of the sheeting, and a concrete filling was placed behind the sheeting outside of and beneath the wall. The design of this support, which was placed a few feet at a time, is shown in an accompanying sketch. In addition, two sets of inclined braces spanning the trench and spaced 10 ft. horizontally took part of the thrust from this retaining wall.

TUNNEL UNDER NEW YORK CENTRAL

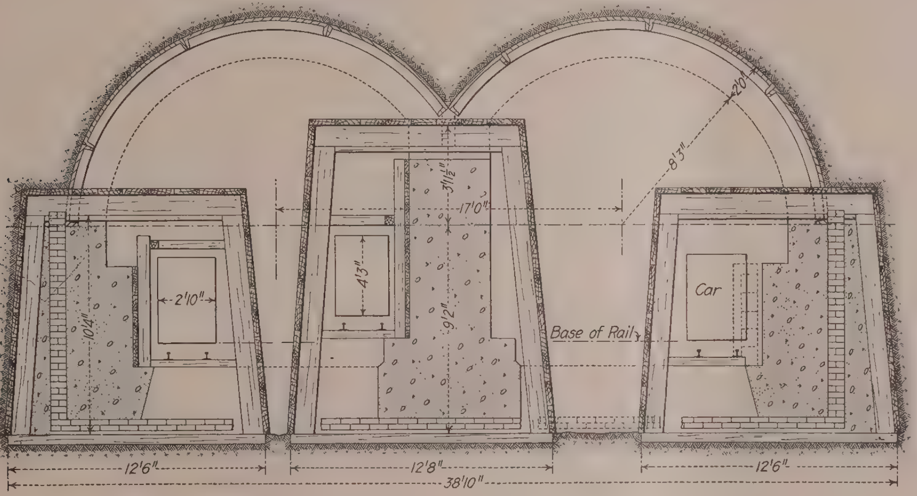
The crossing of the west branch under the New York Central Railroad required careful handling, as the railroad here is on a heavy fill. Each track in this section occupies a separate bore. Three drifts were started from the main cofferdam, one for each of the side walls, and one for the center wall; and though quarters were somewhat cramped, the three walls were successfully concreted. Dirt, timbering, forms and concrete, all were handled on 18-in. gage cars at the side of each drift. The method is illustrated in the accompanying section. When this work had been done a roof shield was started over each tunnel, traveling on top of the concrete walls. As these shields were jacked ahead, cast-iron rings were set behind them to line the arch. The excavation was then finished, and the remainder of the concrete placed. On reaching the north end of the section, the shields were left embedded in the concrete of the roof.

North of this tunnel section the rest of the work of the west branch is being done in open cut. The excavation from this cut not disposed of in the east branch was stored on space available west of the cut,

INVERT CONCRETED AND REINFORCING PLACED IN RIVER TUBE—ROOF-SHIELD TUNNEL UNDER RAILWAY TRACKS and will be used for backfill. This section contains the heavy girders referred to above. The cross-bracing of the cofferdam has been arranged to miss these girders, and the longitudinal bracing is taken out a panel at a time to set them.

Concreting on Bronx Shore

The concrete for the north-shore work is supplied by a mixer set under hoppers at the waterfront, and fed with a clamshell. Arrangements were made for delivering sand and gravel on the same scow, so that the derrick can reach both materials. This system did away with the need for storage space, both here and at the Manhattan plant, and bins of only 100 yd. total capacity were required over the mixers. Concrete is transported by the dinkey in three-car trains carrying six 1-yd. buckets, and is handled to the forms by derricks.



ROOF SHIELDS USED TO BUILD TUNNEL UNDER RAILROAD TRACKS

Portions of sidewalls sectioned were constructed in advance drifts as shown

Little trouble has been experienced from water in the excavations, considering their size and closeness to the river. It must be remembered, however, that these excavations were all bottomed either in hardpan or rock. The excavations on the Bronx shore have averaged 500 gal. of water per minute. Those on the Manhattan side are wetter, and are now making about 1000 gal. per minute.

The work is being done by the Arthur McMullen & Hoff Company for the Public Service Commission for the First District. C. V. V. Powers is engineer of the third division for the commission, and H. B. Gates is section engineer. N. R. Melvin is superintendent, and G. A. Graham chief engineer, for the contractor.

The Marble Columns for the Lincoln Memorial are the largest of their kind in the world, according to an article by J. P. Kirsch in the Scientific American. Each block weighs 35 tons as it comes from the quarry, and twelve blocks are required for each 46-ft. column. When completed, one column weighs 192 tons and involves a cost of $15,000. The stone is being shaped at Marble, Colo.; first the blocks are sized with wire saws to the required thickness, then they are passed through the barrel saw, which cuts them into drums. These drums are trued up upon huge lathes, then fluted by carborundum wheels. Finally they are hand finished and each drum fitted perfectly to the one above and below it.

What the Panama-Pacific Exposition Means to Civil Engineering and Contracting

A $23,000,000 Project, Unique in the Variety of Problems to Be Solved, Carried to Successful Completion by Engineers as Administratives

By A Special Contributor

The Panama-Pacific International Exposition means more to the civil-engineering field than is apparent from a study of the displays or the unusual structures provided to house them. The Exposition itself, an exhibit in its entirety, is the material evidence of what can be done by the civil engineer advanced from the designing room to the administrative office. There have been worked out here features of design and construction of great technical interest, but of much greater importance to the profession as a whole is the fact that the budget was controlled by the engineers. For the first time on a work of this scope and magnitude the civil engineer has been granted full power as administrative as well as executive. In short not only has the engineer come into his own, as it were, on the work, but now that the precedent has been established it is probable that the influence of his success here will be felt long after the Exposition has become history.

It is only fair to say that the architects of the Exposition staff deserve much credit for the consummate skill shown in designing the various courts, the facades of the main palaces and the towers. Architect and sculptor have combined in producing imposing fountains, grouped figures and decorative columns to set off the main structures to advantage, and the highest art of many professions has here blended in the development of a superlative conception of what this Exposition should be. At the height of the work there were engaged upon it twenty-three inspectors, thirty-four electrical engineers and draftsmen, and fifty clerks and stenographers. The organization, the management and the final approval of all this, however, has fallen upon engineers serving in administrative capacities.

Broadened Field for the Engineer

This Exposition has come at a time when much is being said about the broader field of the civil engineer. The Engineering Record has published not a few comments on this subject, and civil engineers of prominence have pointed out the way and made pleas for advance toward a higher standing among the professions. The point has been made repeatedly that with his other qualifications, once the engineer becomes able to appreciate the viewpoint of the financier and the artist, then shall he no longer be rated as the subordinate of one who buys "engineering service" as he does real estate, lumber and cement. That the completion of the Exposition has demonstrated the truth in this idea and the successful manner in which the engineer has executed commissions heretofore usually considered beyond his sphere, are most significant facts which are certain to mean much to the engineering world.

At the outset of the Exposition planning, it seemed that the work involved was "a $23,000,000 project," and it was decided to place absolute control of the entire matter in the hands of competent engineers. If it had been strictly a work of engineering design and construction this would have been wholly in accord with the custom that has prevailed since engineering became a science, but the action of the board of directors has turned out to be a new departure in engineering assignments—a more radical departure than was at first believed. Setting aside matters of design and construction as within the accepted field of the engineer, in building this Exposition he has ranked higher than the architect and has successfully handled a variety of unforeseen questions and problems introduced by recent advancement of the arts and sciences which have produced complications wholly without parallel. Not only have all these situations been satisfactorily met by the engineer management, but for the first time in the history of modern expositions, one has been built within the estimate and with all structures completed before the opening date.

To chronicle the unique situations that have arisen in the building of the Exposition at San Francisco is beyond the purpose of this article, but it is worth while to note that the engineer has there supervised, revised and adjusted in every department, and the president of the organization that carried the work to completion has been called upon most of all as an engineer. Not in the structures themselves, but in the aggregation of structures and the accessories of the completed "plant" has come the wide range in the work devolving upon the management. The direction of so great a variety of activities has been accomplished successfully only because a highly efficient scheme of organization was worked out. The organization was developed by engineers, and to them is also due the credit for handling it in such a way as to coordinate the work of many departments.

It was necessary to purify water and distribute it; to provide and deliver steam, compressed air, and refrigeration service as well as electricity for light, heat and power; to arrange for fire protection, transportation, hospital service and sewage disposal; to codify a set of rules and regulations and arrange to enforce them; to decide between day labor and contract; and above all, to co-ordinate the work of and maintain proper balance among the architects, sculptors, artists, illuminating, electrical and mechanical experts, landscape gardeners, general contractors, decorators and a multitude of others. In short, it was necessary to discharge every obligation that would devolve upon a city manager's office were he required to produce as a "going concern" a modern city equipped complete in every respect, built in a minimum space of time and on a temporary basis. Everything within the Exposition grounds has been required to be amply strong but capable of being easily wrecked in 1916.

THE CONTRACTOR'S PART

No Arabian fairy tale, even with the aid of the Aladdin's lamp idea, ever pictured a creation on anything like the scale of the Exposition, and for the contractor there will be great interest in comparing the grounds as they appear today with the mud flats and tide lands of three years ago. With a strong imagination he could see the reclamation of the site and the structures under way, but it is hard to realize how great an amount of work has been accomplished in so short a time. Construction was begun on Oct. 14, 1912. A 1,700,000-yd. fill was the first item required and then commenced the hurried erection of a dozen enormous timber structures.

Machinery Palace is perhaps the most striking building from the contractor's point of view. It was built in 240 calendar days, an average force of 475 men being employed during the height of the work. The walls had to be carried on a foundation separate from the floors, and special designs in timber joints were required in the columns and trusses. The columns weighed 11 tons and the trusses 7 tons. One of these was put in place every 12 min. of working time during the month of June, 1914. About 8,000,000 ft. b.m. of lumber was used in this palace, which has a roof height of 135 ft. and covers an area of 8 acres. This structure is but one of the many built within the grounds on a similar scale, and the chaos of the construction period can be imagined better than described.

Most of the work within the Exposition grounds has been done under contract, the Exposition company awarding contracts for the separate structures independently, and so far as possible subdividing the work so that the minimum of subletting would be required. A total of about 1000 contracts were let, the largest being for $800,000. In some cases the bids were called for on general designs, the details to be worked out by the contractor, subject to the approval of the Exposition Company. It is notable that no trouble has resulted from this system, and that in general a hearty spirit of co-operation has existed between the contractors and the company. This system has had the advantage of distributing the responsibility to a desirable extent and has given the company a fore-knowledge of costs so that a proper balance of expenditure could be maintained among the various departments as the work advanced.

FINANCIAL SUCCESS

It is not possible to predict expenses exactly, and much less the attendance, but the results of the first month's operation are highly interesting in comparison with the other expositions, and in the light of the plan under which the stock in this Exposition was sold. During the first thirty days the attendance at the Exposition grounds in San Francisco totaled 2,006,405, as against 1,971,245 during a corresponding period at St. Louis in 1904 and 1,468,926 at Chicago in 1893. In these thirty days, and exclusive of the season-ticket revenue, the Exposition Company reports a net profit of $85,410, which is in pleasing contrast to the $210,000 and $120,000 losses which the Chicago and St. Louis Expositions, respectively, are said to have sustained in the same period.

It is expected that with the beginning of the general tide of travel from the East which has already been booked for later in the season, and with the National conventions assembling at San Francisco, the net profits will materially increase. However, the mere fact that there was a profit instead of a loss in the critical initial period has demonstrated that there has been nothing wrong financially with the basis on which the general plan of the Exposition has been developed.

To be more explicit as to finances, the certified statement submitted to the Exposition directors shows for the first thirty days a total revenue from admissions, concessions and miscellaneous sources of $823,882. This does not include season-ticket revenue. In this period operating and maintenance costs amounted to $718,471, and $20,000 was set aside for contractual obligations, leaving a net profit of $85,410. The total revenue from admissions in the thirty days, including permits and season tickets, was $2,024,704.

COST

The cost of the work involved in producing the finished Exposition has recently been compiled by the Division of Works as shown in Table 1. This total covers the amount of the Division of Works budget as authorized Dec. 8, 1914. The total of this and other work handled by the Division of Works for other departments of the Exposition Company is shown in Table 2.

TABLE 1—COST OF EXPOSITION CONSTRUCTION COVERED BY DIVISION OF WORKS BUDGET

General construction	$2,080,000
Mechanical and electrical features	430,000
Fire protection	179,000
Gardens and planting	497,000
Buildings	5,429,000
Decorative features	1,889,000
Miscellaneous items	107,000
Operating equipments	96,000
Division of works, administrative engineering and architecture, and superintendence	1,060,000
Site acquisition	1,162,000
Exposition auditorium	1,080,000
California building	416,000
Total	$14,425,000

TABLE 2—TOTAL OF BUDGET AND OTHER DIVISION OF WORKS COSTS

Dec. 8, 1914, budget	$14,425,000
Division of exhibits	400,000
Division of concessions and admissions	110,000
Division of exploitation and publicity	650,000
Special unattached departments	450,000
Administration	375,000
Miscellaneous expense	375,000
Promotion	375,000
Total	$17,160,000

In addition to the foregoing the Division of Works has passed upon the other work carried on within the grounds for which minimum estimates are as shown in Table 3.

TABLE 3—ESTIMATED COST OF OTHER WORK WITHIN THE GROUNDS

Foreign buildings	$1,000,000
State buildings	1,000,000
Special buildings	500,000
Concessions	2,750,000
Total	$5,250,000

Recent appraisals of exhibits place the cost of work involved in displays at $10 per square foot, and for 2,700,000 sq. ft. of exhibit space this totals $27,000,000. A final summary of the cost of producing the Exposition as a "going concern" would therefore be roughly as shown in Table 4.

TABLE 4—ESTIMATED TOTAL COST OF PRODUCING THE EXPOSITION

Exposition Company (including overhead)	$17,500,000
Other construction	5,250,000
Exhibits at $10 per square foot	27,000,000
Grand total	$49,750,000

EDUCATIONAL FEATURES

In common with every other visitor, the engineer who goes to the Exposition grounds will find there much of interest in his own line of work. "Educational" is the theme upon which all exhibits have been assembled, and throughout every palace and department there is manifest the endeavor to bring out the principle upon which the method or machine depends and to facilitate explanation and study. Nearly all displays of mechanical equipment show the machines in operation, often with working parts in section, or moving within transparent cases.

Representing the President of the United States at the dedication ceremonies on March 25, Vice-President Marshall, in speaking of the Exposition, said in part: "This is the university of the world. It has a chair fully endowed to meet the wants and the needs of each. The eye, the ear, the mind, the heart, the soul each may have its horizon here enlarged. I came to bear a message. I remained to become a student. If there be anyone in America with a thirst for knowledge and for beauty and a longing for a liberal education such a one can here obtain it. Whoever can, even at a sacrifice of something which for the moment appears necessary, should come to see a real work of art never equaled even by a mirage."

FREE SAND IMPORTED FROM EUROPE is being used in the construction of the new subways in New York City. This is not because suitable sand cannot be obtained in this country, but because the war in Europe has cut down the cargoes which steamships ordinarily bring from the other side of the Atlantic to such an extent that it is necessary for many ships to come over in ballast, and they have been using beach sand as ballast. Upon arriving in New York this sand is discharged to make room for the returning cargoes, and is practically given away by the steamship company to anyone who will haul it away and dispose of it. Rodgers and Hagerty, Inc., who have the contract for the construction of Section 15 of the Lexington Avenue subway, extending from about 138th Street and Park Avenue through Mott Avenue and Franz Sigel Park and River Avenue to 157th Street, have used ten scowloads of this sand in backfilling.

Expansion and Contraction of Concrete Building Measured

Vagaries of Changes in Length, Due to Variations in Temperature, Are Disclosed in Tests on Structure in Cambridge, Mass.

IN November, 1913, Professor Howard of the Massachusetts Institute of Technology made very careful measurements of the Gray & Davis Building, in Cambridge, Mass. This was at the instance of the builders, the Aberthaw Construction Company, of Boston, and has formed the basis for subsequent study of the expansion and contraction of a large reinforced-concrete building under varying temperatures. At the same time Professor Howard established a number of points along the water-table, and similar points inside the parapet of the roof, exactly above the corresponding water-table points. A study of the movement of the upper points with respect to the lower points was made.

On the date of the original measurement, Nov. 7, 1913, the average temperature on the roof was about 57 deg. Fahr. and at the base about 70 deg. When the building was again accurately measured, on Feb. 12, 1914, a particularly cold day, the temperature upon the roof was about 6 deg. and at the base about 17 deg. Further measurements were taken Sept. 1, 1914, when the temperature was about 90 deg. at the base and 82 deg. on the top floor.

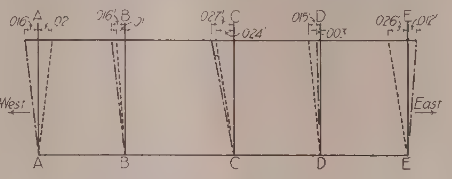
The varying lengths of the building, measured between points accurately established near the two ends, are found in the accompanying table. In each case the measurement given is the average of several determinations.

VARYING LENGTHS OF BUILDING BETWEEN ESTABLISHED POINTS

	Temperature, deg. Fahr.		Length, ft.	
Date	Base	Roof	Base	Roof
Nov. 7, 1913...	69.8	56.9	382.559	379.437
Feb. 12, 1914...	17.4	6.2	382,552	379.377
Sept. 1, 1914...	90.0	82.0	382.580	379.483

VAGARIES OF LENGTH CHANGES

It is evident that between November and February the base had contracted by 0.007 ft., or about 1/12 in. The corresponding shrinkage at the roof was 0.06 ft., or nearly ¾ in. Assuming that some time between February and September the conditions of the previous November were reproduced (considering the November readings as the basis for our study) the expansion of the building between November and September amounted at the base to 0.021 ft. or ¼ in.; at the roof, 0.046 ft., or a little over ½ in. It is somewhat curious that the base should show three times as great a change in expansion as it did in contraction, while the change in the roof was less in expansion than in contraction.



RELATIVE MOVEMENT OF POINTS ON PARAPET WITH RESPECT TO BASE

Figuring this out on the basis of change in length per degree variation in temperature, it appears that the contraction between November and February, along the base, was 0.0016 in. for each degree. On the roof, the corresponding figure was 0.0142 in. Between November and September the corresponding change per degree Fahrenheit was, at the base, 0.0126 in., or about eight times as much as for the previous contraction; at the roof, 0.0221 in., or 50 per cent more than for contraction.

Figuring these same results between February and September, thus covering the greatest range in temperature observed, we find that the base expanded 0.0046 in. per degree, while the roof expanded 0.0168 in. per degree.

In some ways the most interesting feature of the study is the movement of the points located on the parapet, as compared with the points at the base, which may be considered as fixed. The diagram shows by heavy vertical lines the condition in November, 1913, when the lines from upper point to lower point were exactly vertical. The dotted line shows in each case the movement of the upper point with regard to the lower, as measured in February, 1914; while the dot-and-dash line shows the positions last September. The September measurements were made almost exactly one year after the Aberthaw Construction Company finished pouring concrete in the building.

LOCATION OF POINTS OF REFERENCE AT PARAPET AND BASE OF BUILDING

While the contraction of the building, as measured in February, seemed to be about some point between *A* and *B* in the illustration, it is less easy to fix the location of the point about which expansion took place later, although it must have been not far from *D*. A curious feature, however, lies in the fact that the four sections of the building between measuring points expanded and contracted irregularly. When the building contracted as a whole, one section of the building showed actual expansion, and vice versa. This must have been due to local causes which have not been determined—possibly to interior conditions of heating. The table shows the relative movement of the different sections about the original vertical lines:

RELATIVE MOVEMENT ABOUT ORIGINAL VERTICAL LINES

Section	February, 1914		September, 1914	
AB	Contracted	0.03 ft.	No change	
BC	Contracted	0.014 ft.	Contracted	0.011 ft.
CD	Expanded	0.009 ft.	Expanded	0.024 ft.
DE	Contracted	0.011 ft.	Expanded	0.015 ft.
AC	Contracted	0.044 ft.	Contracted	0.011 ft.
CE	Contracted	0.002 ft.	Expanded	0.039 ft.
BD	Contracted	0.005 ft.	Expanded	0.013 ft.
AE	Contracted	0.046 ft.	Expanded	0.028 ft.

Although Chlorinated, B. Coli Increase in Number

H. E. Jordan, Chemist for Indianapolis Water Company, Discusses Standards of Purity for Water on Interstate Carriers

MULTIPLICATION of B. coli in bleach treated waters in summer has been noted by H. E. Jordan, chemist for the Indianapolis Water Company, in a recent paper presented to the Indiana Sanitary and Water Supply Association. Mr. Jordan was controverting a statement which appears in the report of the experts promulgating a standard of purity for interstate carriers. Of 201 samples, 21 gave positive B. coli reactions immediately after treatment, 39 after 24 hours standing and 42 after 48 hours. The increases were confined to the warm months. From November to April actual decreases were noted. These studies are now being carried out in greater detail to obtain all possible information as to the ability of a bleach-treated filtered surface supply to meet the standards after various lengths of exposure to various temperatures.

There still remains a tendency among filter men to avoid giving out definite information on their B. coli findings, which indicates, said Mr. Jordan, a mistaken idea that these bacteria are necessarily a bad indication or at least that a statement of such findings will be the basis for criticism. He gave, however, results from four plants. For nine years Washington, D. C., operating with a raw water carrying B. coli 18 per cent of the time, has reduced the presence of the organism in 1-cu. cm samples to 0.8 per cent of the time. At Indianapolis, for eight years B. coli were present in the raw water 48 per cent of the time and in the effluent 3.1 per cent. Lawrence raw water carries the germ in large numbers at practically all times. Its filtered water samples for 17 years have contained B. coli 10.8 per cent of the time, ranging as high as 18 per cent for three years. At Harrisburg the raw water is rarely free but the average percentage of time during eight years when B. coli were present in the effluent was 1.1. In these cities water has been eliminated as a factor in typhoid fever causation. Data from Pittsburgh and Albany are too meager for tabulation but show that these plants do not continuously attain the carriers' standard. However, both plants have effected marked and continued reduction in typhoid death rates.

Mr. Jordan concluded that while the standards are not intended for public water supplies, their operation necessitates their conforming to it; that the assumption of non-multiplication of B. coli is not beyond dispute, and that public water supplies are being safely used which do not continuously meet the standards.

Developments in Federal Evaluation During April

DURING April, states a bulletin issued by Thomas W. Hulme, general secretary of the Presidents' Conference Committee, three new orders were issued by the Interstate Commerce Commission in connection with the Federal evaluation of the common carriers. Order 14 requires certain carriers to furnish detail information as to prices paid within recent years for materials and labor. Order 15 requires a schedule of certain leases, and summarized statements of income from other leases. Order 16 requires information as to aids, gifts, grants and donations.

A list of eighty-three railroads is given on which it is contemplated to start work between July 1, 1915, and June 30, 1917. These include twenty-three roads in the Eastern District, thirteen in the Southern, seventeen in the Central, three in the Western and twenty-seven in the Pacific. Approximate tentative dates for starting the work are given.

There has been no further postponement of the general valuation conference to be held by the Division of Valuation at Washington. and the date last announced, May 27, still holds.

Sand-Asphalt May Solve Florida Road Problem

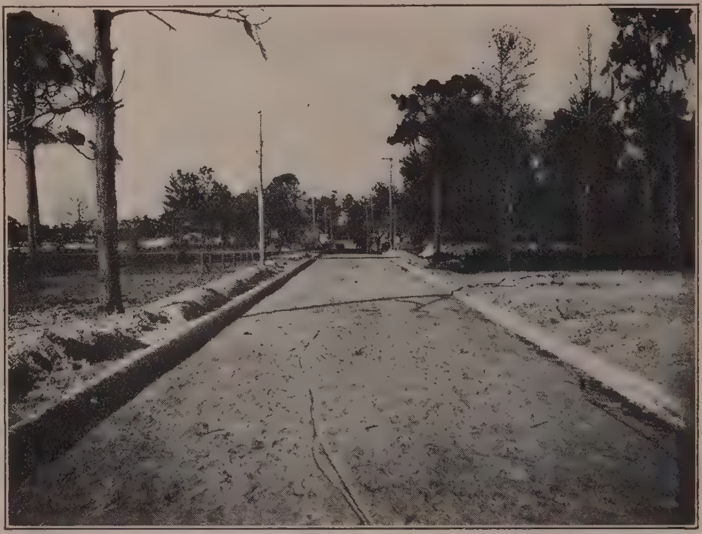
One Section, Built by Hand-Mixing Method, Gives Good Results After Two Years of Service

By CHARLES E. FOOTE
Lately with Florida Good Roads Association

THE construction of sand-asphalt roads in Florida covers only a period of about two years; but so successful has this type of road shown itself to be, within this limited period, that a considerable mileage is now under construction and more is in contemplation.

The first sand-asphalt road in Florida was laid in January, 1913, on the street fronting the Ocklawaha hotel at Eustis, Florida. This hotel had been the property of John S. Lane of Meriden, Conn., until his death. A son of John S. Lane was identified with the Lane Construction Company, which since 1907 has been working on the sand-asphalt construction on the Cape Cod peninsula, under the direction of the Massachusetts Highway Commission. He considered that the principles which had proven successful in Massachusetts would be applicable to Florida with certain modifications.

SAND ROAD AT TARPON SPRINGS—NOTE SAND-ASPHALT PLANT IN BACKGROUND



SAND FOUNDATION WITH CURBS AND STAKES READY FOR SAND-ASPHALT SURFACE

After an arrangement with Eustis city officials Mr. Lane sent to the Lane Construction Company for a superintendent, a small number of experienced laborers and equipment. The balance of the labor was employed locally.

Method of Mixing

Six hundred feet of pavement 15 ft. wide was built entirely by a hand-mixing method. The materials were Florida sand and asphaltum. The sand was heated on a platform made of wrought-iron piping, and the asphalt melted in kettles; the mixing was done by hand on wooden mixing platforms. Then the mixture was spread to a thickness of 2½ in. and rolled with a heavy roller. The proportions of the mixture were about 9 per cent asphalt and 91 per cent sand.

The foundation is of sand, wetted and compacted under a 10-ton roller. Florida sand makes a solid foundation as long as it is protected from the action of air and water.

This pavement, after more than two years of satisfactory wear, still retains its surface and contour, and so far as its appearance is concerned possesses all the stability and lasting qualities of a sheet-asphalt pavement. With ordinary attention there is no apparent reason why it should not last twenty to twenty-five years.

During the summer of 1914 a careful study was made of Florida conditions by John Baker, Jr., of Chicago and New York, with his Florida office at Tampa. A staff of competent chemists and engineers went into different sections of the State, to study climatic and travel conditions, and analyze sands in different localities. Their report indicated to the mind of Mr. Baker that Florida sand in a proper mixture with asphaltic cement will make a pavement better adapted to Florida traffic conditions than other pavements which cost two or three times as much. During the fall of 1914, and the winter just past, a large yardage of this pavement has been laid.

Portable Plants

The present practice involves the employment of a portable paving plant with the various units mounted on wheels. These plants each consist of four units—boiler and engine; heater and pugmill mixer; melting kettles, and a heavy steam or gasoline roller. This plan permits the construction of the road with the plant close at hand, and the laying of the surfacing material without lowering its temperature by a long haul. The mixed material can be taken from the plant to the roadway in wagons, carts or wheelbarrows, according to the distance.

Bonds amounting to nearly a million dollars have been voted by counties and road districts in Florida for sand-asphalt construction. This type of pavement has been or is being laid in the cities of Tarpon Springs, Sarasota, Mount Dora and others, and officials of the United States Office of Public Roads, after a thorough investigation, have made a favorable preliminary report on this type of pavement.

On the east coast of Florida a section of sand-asphalt road is under construction. This road is 6 miles long and extends from Riveria, a station on the Florida East Coast Railway a few miles north of West Palm Beach, westward to a real estate development. The road is being financed by private interests with the consent of the county authorities. Another similar road, or combination of roads, totaling nearly 100 miles in length, has recently been under consideration by the large land companies involved. This, like the Riveria project, will be paid for by the private interests concerned in the land development.

COSTS NOT AVAILABLE

Official cost data for sand-asphalt construction have not as yet been authoritatively announced. According to the best information obtainable at this time, the cost ranges from 70 cents to 90 cents per square yard, according to local conditions. In localities where the travel requires less thickness of surface the cost should be less.

Florida has an area of 58,000 sq. miles, or 37,120,000 acres. Of this area, approximately 27,000,000 acres are uncultivated. It is mostly land from which the timber has been cut and left with underbrush and stumps, though there are some areas of native timber still awaiting the axe, and some forests which are given to the production of turpentine and rosin, but these form a small percentage.

Of the other 10,000,000 acres, possibly 2,000,000 acres are under cultivation; two more million acres are swamp, subject to drainage (not counting the Everglades, which are a part of the 27,000,000 acres), and about 6,000,000 acres may be embraced in the area covered by the lakes and streams which abound.

PROSPECTIVE ROAD MILEAGE

When in the development of Florida's resources, roads shall be built on every section line, Florida will have about 116,000 miles of roads, instead of approximately 20,000 miles as it now has. The water area may reduce this somewhat, say to 110,000 miles. Of this mileage, approximately 15 per cent, or 16,500 miles, will be main roads, requiring a hard surface, and of the main roads, probably between 2000 and 3000 miles will require the highest type of construction, with permanent foundations and the most durable surface obtainable.

With a careful study of conditions and materials, and costs, it would appear that the sand-asphalt road has an excellent opportunity to achieve a high destiny in working out the development of Florida.

SPREADING AND MIXING THE HOT MIXTURE BEFORE ROLLING, AND COMPLETED SAND-ASPHALT PAVEMENT

Tour of West Discloses Best Practice in Irrigation and Power Canal Design

Slopes and Lining Thickness Should Depend on Nature of Material Encountered—Discussion Embraces Grades, Cross-Section and Alignment of Canal

By C. A. FARWELL

With Fay, Spofford & Thorndike, Consulting Engineers, Boston

DURING the winter of 1912-13 the writer visited a number of irrigation and power projects in the West, to study costs and determine the best practice in the design and construction of concrete linings for large canals. The investigation included the alignment, grades and cross-sections of the canals. Data were obtained partly by observation and partly from the engineers associated with the work. The information was transmitted in the form of a report to the Pearson Engineering Corporation, New York City, for use in the design and construction of the canals of the Riegos y Fuerza del Ebro, S. A., Barcelona, Spain. Some of the points brought out are given herewith.

DESIGN

It is assumed that the capacity of the canal to be designed is fixed by outside considerations, either the available supply or the amount needed for the project. On irrigation work the main canal is designed for a constant flow over a period of several months of the year, while on power development there are hourly fluctuations, depending directly on the power loads. In this latter case it is of course necessary to make the canal of sufficient capacity to handle the "peak" loads. If at all possible it is customary to provide storage reservoirs above, and sometimes below, the power houses, to take care of these hourly fluctuations, as was done on the Los Angeles Aqueduct, where the conduit has a capacity, in general, of 430 sec.-ft., while the section which includes the power drops has a capacity of 1000 sec.-ft. between two reservoirs. The shorter this section can be made the better.

In designing the cross-section of the canal, there are two general classes, into one of which the canal under consideration may be placed: (A) Where the grade is fixed by the topography or by elevations of the intake and outlet, and (B) where the canal grade is not fixed, but is dependent on the relation between costs of construction and value of head.

(A) Where the Grade Is Fixed

The fixing of the grade determines, within close limits, the velocity of the water in the canal and the area of the cross-section. The grade may be such that the velocity will be low enough to permit the use of an unlined canal, but even if this is the case, it is possible that lining will increase the capacity or cut down the excavation and seepage to an extent that will more than pay for the extra cost. In general, the points to be considered are as follows:

(1) *General Shape of the Section.*—The trapezoidal section is by far the most generally used, and any disadvantages that it may have are usually considered to be of no importance. It is claimed by some engineers that a small curve in the corners is an improvement, but this is doubtful. If the lining is not built in place, the semicircular section is probably the most economical. Where there is any possibility of upward pressure on the bottom the curved bottom is an improvement, as it is very little, if any, more expensive than the flat bottom.

The relation of the bottom width to the depth is dependent largely on the cross slope of the country through which the location passes, but there is a certain proper hydraulic relation that should be considered. It can be shown by computation that there is a certain relation between the bottom width and the depth that gives a maximum hydraulic radius and a resulting maximum capacity for any given canal grade.

Theoretical computations, with assumed conditions closely approximating those actually encountered, will determine the most economical shape of section to use.

(2) *Location with Relation to Natural Ground Surface.*—In country where the

cost is not excessive, it is considered good practice to locate the canal entirely in "thorough cut" if concrete lining is to be used. It seems to be practically impossible so to compact a fill that there will not be settlement, with its resulting displacement of the lining. Judgment must of course be used in determining to what extent the location shall follow the contour, as it is impossible to do away entirely with small fills in rough country.

It is noticeable that where canals have been built for some time and run into fills for short stretches there is almost invariably a large crack at, or near, the place where the canal passes from cut to fill or vice versa. Attempts are made to care for this, in more modern construction, by reinforcing the lining across the fill section, and this seems to be good design. Where it is necessary for a part of any section to be against other than natural material, as may happen on a very steep side hill, it appears to be good practice to lay up a rubble wall, either dry or with mortar, as a backing for the concrete. Otherwise the sides may be reinforced or buttressed at intervals, but where labor is cheap this latter type of construction would probably be more expensive.

FREEBOARD

The amount of freeboard used is largely a matter of judgment, but this judgment should be based on several things, viz., the wave action, dependent on the velocities of the water in the canal, and of the wind; the unknown action of the water surface on sharp curves and at changes of section; the desirable or possible "over-capacity" of the canal, and the damage that would result from an overtopping of the edge by the water. It might be advisable to build the lining only one-half or one-fourth of the distance from the theoretical water surface to the top of the bank, allowing the backfilled bank to supplement the concrete freeboard in extreme cases.

In regard to alignment, there seems to be no objection to curves down to 150 ft. radius or less, provided the velocity is not excessive.

It is doubtful, at least in the writer's opinion, if anything is gained, except possibly in appearance, by a too close adherence to the standard section or located line. After the excavation is made the lining should be placed on the side slopes as they lie. The bottom, of course, should be kept carefully to grade. For instance, if the excavation leaves the bottom a foot too wide in places, nothing would be gained by backfilling to the standard width. In the same way, if the alignment is off a few feet in places, no material harm is done. An extremely accurate alignment results only in a "nice looking" job, at considerable extra expense.

(3) *Slope and Thickness of Side Lining.*—This is almost entirely dependent on the nature of the material encountered. In a rock cut a thin lining (say 2-in. minimum) on a ½:1 slope is good practice; in a pervious soil, where there would be no danger of pressure behind the concrete, a thin lining on 1:1 or 1½:1 side slopes might be used. Other thicknesses would be used in other kinds of ground, and the question of just the proper thickness is dependent on local conditions. The slope can usually be safely made the stable slope of the material back of the concrete. Where there is danger of water pressure or of the action of frost behind the lining, this must be considered, and in some cases "weepers" may be put in at intervals to prevent such pressure, these "weepers" to discharge into the canal or outside, as thought best.

(4) *Expansion Joints.*—If considered necessary, on account of a very porous backing, special joints may be used; but, as a rule, the cracks between the different panels of the lining, as built, serve all purposes. Expansion of the concrete when thoroughly saturated with water tends to close all these temporary "contracting" cracks. If found advisable, any cracks may be filled, after a season's operation, with cement grout or asphalt.

(5) *Surface of the Concrete.*—Where forms are used very little can be done to reduce the coefficient of friction after the removal of the forms. If the forms are carefully made, and maintained, of smooth lagging, and the concrete is well spaded, a dense, smooth surface is obtained that can hardly be improved. In order to fill any small air or water voids, it may be well to "wash" this surface with a thin grout, but even this is doubtful. The coefficient n in Kutter's formula for such a surface is about 0.013, and if clean metal forms are used may be as low as 0.012, but in the writer's opinion conservative practice would not permit of the use of a lower figure in the computations for the design.

SURFACING THE CONCRETE WHERE FORMS ARE NOT USED

Where forms are not used, the best practice seems to be to go over the surface with a lean mixture of sand and cement as soon as possible after placing the concrete. It is much better to do this within an hour or two than to allow a day or several days to pass before the plaster is put on. In the covered sections of the Los Angeles Aqueduct the concrete was very damp when the forms were removed, and remained that way for several days; hence the plastering could be delayed with less liability of inferior work.

Care must be taken in plastering, or the surface will "shell off" in time; some engineers are of the opinion that it is almost never entirely reliable. It would seem that the proper value for n is between 0.011 and 0.015, depending on the care used, with 0.013 for an average.

Considering the fact that a smooth and impervious concrete lining can only be obtained without forms by the use of a plaster coat, and this of questionable reliability, it seems better to use forms where at all possible.

(6) *Reinforcing.*—It is probably unnecessary to use reinforcing where the lining is laid on undisturbed or well settled material, unless such material is very porous and seepage dangerous, and even in such cases it seems better to lay the concrete without reinforcing in panels with special, watertight expansion joints. When lining is placed over fills it is good practice to reinforce.

(B) Where the Grade Is Not Fixed

Where the grade is not fixed a seventh factor, the value of head, must be taken into consideration. Between the cheapest possible development of the project and the most expensive there is a design that will give the largest return on the money invested. The grade of the canal is one of the important factors, and the relation between the cost of construction, which varies inversely with the grade (the steeper the grade the less the cost), and the value of head will determine the proper grade to use.

METHODS OF CONSTRUCTION

Two methods of preparing the surface for concreting have been generally used. In one, all overbreakage is filled with rubble, this method being necessarily confined to location wholly or partly in rock. In the other method the overbreakage is filled with tamped or puddled earth. The puddling may be done in two ways, either by the use of forms of the dimensions of the outside of the proposed concrete, or by the use of guides, where the material is tamped up to the proper line. The use of forms or guides is largely determined by the proposed use or absence of forms for the concrete, forms being used for the backfilling if forms are to be used for the concrete.

The sides are almost invariably concreted first. Where the slopes are ½:1 or steeper, forms are always used; where they are 1½:1 or flatter, no forms are used; but on the 1:1 slopes, both methods are in common use and engineers differ as to which method gives the better results at the lesser cost. The difference in opinion probably arises from the different systems used. It is the experience of the writer and others that if the lagging of the forms is carried up only a little ahead of the concrete no trouble is found in placing concrete behind forms on a 1:1 slope, or even on one considerably flatter.

Where forms are used the concrete is usually placed continuously in lengths of from 12 to 15 ft., with transverse joints between the panels. As soon as possible after the removal of the forms the surface is washed with a grout.

Where forms are not used the surface to be concreted is divided by guides into panels from 12 to 16 ft. square, and alternate panels are placed. The guides are then removed and the remaining panels are concreted. Except in a few cases, no attempts have been made to provide expansion joints other than the planes of weakness occurring between panels put in at different times. These joints have in some cases been grouted and in others filled with hot asphalt. A "dry" concrete is necessarily used where there are no forms. A plaster coat is usually put on the surface after concreting, either immediately or within a few days, care being taken to keep the concrete damp in the meantime.

The mixer is ordinarily set on the bank and discharged into cars or carts running on or above the canal bottom, and from there is shoveled upon the slope or into the forms. As much spading as desired can be done back of forms, but concrete placed on slopes without forms can be "worked" only a little, with a resulting lack of density.

COSTS

The costs obtained were not entirely reliable, as in many cases no accurate figures were available. The minimum figure was 3¾ cents per square foot, for several miles of lining ¾-in. thick, laid under almost ideal conditions; the maximum was 25.7 cents per square foot, for a short piece of lining laid 8 in. thick on the slopes and 6 in. thick in the bottom. Practically all costs were between 2½ and 4 cents, with an average of a little more than 3 cents per square foot per inch of thickness.

Literature

For the Civil Engineer and Contractor

New Publications

Government of the Canal Zone. By George W. Goethals, Governor of the Canal Zone. Cloth, 5¼ x 7½ in.; 105 pages; illustrated. Princeton, Princeton University Press. $1 net.

Moment Diagrams and Typical Live Loads. By Charles Derleth, Jr. Paper, 7 x 10½ in.; 9 pages; one diagram. Berkeley, Cal., Bulletin 1 of Department of Civil Engineering, The University Press. 10 cents.

A complete form of moment diagram for engine loadings is explained and its use discussed.

Materials of Construction—Their Manufacture, Properties and Uses. By Adelbert P. Mills, M.C., C.E., assistant professor of materials, College of Civil Engineering, Cornell University. Cloth, 6 x 9 in.; 682 pages; illustrated. New York, John Wiley & Sons, Inc. $4.50 net.

County and Municipal Indebtedness, 1913, 1902 and 1890, and Sinking Fund Assets, 1913. Department of Commerce, Bureau of the Census, William J. Harris, director. Paper, 9 x 11½ in.; 228 pages; tables. Washington, Government Printing Office.

The Strength of Long Seasoned Douglas Fir and Redwood. By Arthur C. Alvarez. Paper, 7 x 10½ in.; 10 pages; illustrated. Berkeley, Cal., Bulletin 2 of the Department of Civil Engineering, The University Press.

Tests made upon timber which had been air seasoned for 37 years and in actual use in a building as wall studding, floor joists and underpinning.

The Compressive Strengths of Portland Cement Mortars of Various Proportions. By Arthur C. Alvarez. Paper, 7 x 10½ in.; 4 pages; one plate. Berkeley, Cal., Bulletin 4 of the Department of Civil Engineering, The University Press.

Average results of 175 compression tests of 2-in. cubes.

Some Physical Properties of Magnesian Cement Mortars and Concretes. By Arthur C. Alvarez. Paper, 7 x 10½ in.; 43 pages; illustrated. Berkeley, Cal., Bulletin 3 of the Department of Civil Engineering, The University Press.

Uses and physical properties of magnesian cement used in the manufacture of artificial building stone are discussed and the results of tests given in detail.

Seventh Annual Convention of the Atlantic Deeper Waterways Association. Report compiled and edited by Wilfred H. Schoff, secretary-treasurer. Paper, 6 x 9 in.; 328 pages; illustrated. Philadelphia, Atlantic Deeper Waterways Association, Crozer Building.

Reports the proceedings of the meeting held Sept. 22-26, 1914, opened at New York and continued as an expedition in waters adjacent to New York and up the Hudson River as far as the head of navigation.

The Drainage of Irrigated Land. By R. A. Hart, supervising drainage engineer. Bulletin 190, U. S. Department of Agriculture. Paper, 6 x 9 in.; 34 pages; illustrated. Washington, Government Printing Office.

Presents in concise form the fundamental principles upon which is based the reclamation of irrigated land that has become waterlogged and impregnated with harmful mineral salts. Typical conditions and the best methods of treating them are described, and practical advice is offered as to actual operations.

Survey of Northern and Northwestern Lakes. Bulletin 24, U. S. Lake Survey, April, 1915. Paper; 7¾ x 10 in.; 474 pages. Detroit, U. S. Lake Survey Office.

This bulletin and supplements are published to supply the detailed descriptions of shore line and shoals, river and harbor improvements, results of surveys, magnetic determinations, and particulars of constantly changing conditions on the Great Lakes, which cannot be fully shown by the Lake Survey charts. They supplement the information given on the charts, and are issued free of charge to navigators and other chart purchasers. Supplements will be issued monthly from May to November.

Report Upon the Cypress Creek Drainage District, Desha and Chicot Counties, Arkansas. By S. H. McCrory, O. G. Baxter, D. L. Yarnall, L. A. Jones and W. J. Schlick, drainage engineers. Bulletin 198, U S. Department of Agriculture. Paper, 6 x 9 in.; 20 pages; tables, maps and profiles. Washington, Government Printing Office.

Describes an interior drainage system to supplement the sixty-odd miles of levee built to protect this Cypress Creek district from the floods of the Mississippi and Arkansas Rivers. Discusses present drainage conditions, the survey, the drainage problem, runoff investigations, and the drainage plans considered and recommended.

Development and Present Status of City Planning in New York City. Report of the Committee on the City Plan, Dec. 31, 1914. Cloth, 6¾ x 10 in.; 76 pages; illustrated. New York, Board of Estimate and Apportionment.

This report contains a detailed statement of the work of the Committee on the City Plan, given in Chapter 1. Six additional chapters are devoted to the papers presented at the meeting of the Advisory Commission on City Plan, as follows: Work of Earlier Planning Commissions, by Robert H. Whitten; Development of the Official City Map since 1898 and the Work of the New York City Improvement Commission, by Nelson P. Lewis; Work of the Brooklyn Committee on the City Plan, by Frederic B. Pratt; Development of Port and Terminal Facilities, by E. P. Goodrich; Transit Development, by D. L. Turner; Recreation, Civic Architecture, Building Districts and General Summary of Present City Planning Needs, by George B. Ford.

U. S. Geological Survey Bulletins. Paper, 6 x 9 in. Washington, D. C., Government Printing Office.

Profile Surveys—Williamette River Basin, Oregon, Water-Supply Paper 349; 8 pages; 16 maps.—Bear River Basin, Idaho, Water-Supply Paper 350; 7 pages; 6 maps.—Missouri River from Great Falls to Three Forks, Mont., Water-Supply Paper, 367; 8 pages; 13 maps.—Wenatchee River Basin, Washington, Water-Supply Paper 368; 7 pages; 8 maps.

Results of Spirit Leveling.—In Michigan, 1911 and 1913, Bulletin 559; 79 pages.—In Maryland, 1896 to 1911 inclusive, Bulletin 563; 80 pages.

Springs of California. By Gerald A. Waring. Water-Supply Paper 338; 410 pages; illustrated, diagrams and plates.

Surface Water Supply of the United States—1912, Part XI, Pacific Coast Basins in California, by H. D. McGlashan and G. C. Stevens; Water-Supply Paper 331; 442 pages; tables.— 1911, Part XII, North Pacific Coast Drainage Basins, by F. F. Henshaw, G. C. Baldwin, G. C. Stevens and E. S. Fuller; Water-Supply Paper 312; 706 pages; maps and tables.

Stream-Gaging Stations and Publications Relating to Water Resources, 1885-1913; Part VI, Missouri River Basin, and Part VII, Lower Mississippi River Basin. Compiled by B. D. Wood. Water-Supply Papers 340-F and 340-G; 81 and 93 pages respectively.

Books Reviewed

Engineering Economics

Author, John Charles Lounsbury Fish, professor of railroad engineering, Leland Stanford Junior University. Cloth, 6 x 9 in.; 217 pages. New York, McGraw-Hill Book Company, Inc. $2 net.

Reviewed by **Allen Hazen**

Consulting Engineer, New York City

This book is intended primarily to meet the needs of the student and is for classroom use, but it is also intended to render effective service in the office. It deals with first principles only, but these are stated clearly, concisely and as fully as is necessary.

Part I, occupying only a few pages, is introductory. Part II deals with the elements of the preliminary information to be used in the subsequent discussion. It treats of interest and sinking funds, of first cost, salvage value and depreciation, and of the elements of the yearly cost of service. The chapter on estimating is particularly good and contains a very concise statement of underlying principles that must be followed in order to reach a reliable estimate of the whole first cost of structures and works. It will be fortunate when the complete methods of estimating and of calculating costs developed in these chapters become more generally recognized. A full appreciation of their significance will go a long way toward the solution of many questions in valuation and rates.

Part III deals with the principles to be followed in comparing estimates and in determining which of several projects or methods or materials or sizes is most advantageous. The presentation is general in form, sound in principle, brief and easily followed. It is illustrated by a number of well chosen examples to make the methods clear to all readers. The use of formulas and a fairly long schedule of letters designating the various data adds to the conciseness and precision of statement. On the other hand it is difficult to carry in mind and its use adds somewhat to the difficulty of following the argument.

Part IV is a bibliography, and is extended to include a synopsis of the contents of the more important works that are mentioned. Part V consists of tables and formulas for interest, present worth, sinking funds, depreciation, etc. These are conveniently arranged for engineering use. The index is complete, but the book is not one in which special subjects can be easily looked up. It is rather one that must be read through and the argument followed in order that its good points may be appreciated.

Electric Railway Handbook

A Reference Book of Practical Data, Formulas and Tables for the Use of Operators, Engineers and Students. By Albert S. Richey, E.E., consulting engineer, professor of electrical engineering, Worcester Polytechnic Institute, and Fellow of the American Institute of Electrical Engineers; assisted by William C. Greenough, E.E. Limp leather, 4½ x 7 in.; 832 pages; illustrated; diagrams and tables. New York, McGraw-Hill Book Company, Inc. $4 net.

Most of the matter in this book of interest to railroad civil engineers will be found in the first three (220 pages) of the eleven sections, on roadbed and track, buildings and train movement, respectively. The remaining eight sections deal chiefly with equipment and power. Scattered through them, however, is matter of general railroad interest, on such subjects as catenary construction, steel and reinforced-concrete poles, timber preservation and the main features and dimensions of electric locomotives and rapid-transit cars.

The first section, in undertaking to cover roadbed and track in 95 pages, undertakes much. Location surveys are dismissed in half of the first page. Inconsistently, the next three pages are given to engineering costs, from which the reader learns only that these have varied from 2 to 9 per cent on numerous pieces of work cited. Sixteen pages devoted to handling earthwork give useful information that would be more useful if the paragraphs were shorter and the units derived more conspicuously presented. Following some rather incomplete track sections in open cut are valuable diagrams showing track construction in paved streets in various cities, and tabular matter on the same subject. Further along are sections of subways in American and foreign cities. Because street-railway track work and details are so different from steam-railway practice, the remainder of section 1 will not interest, except in parts, civil engineers not in street-railway work.

Because, again, of the crudeness of street-railway frog and switch work as compared with that of steam railways, the first part of the 38-page section on buildings, which has to do with carhouse layouts, will interest only those in that special work. The structural engineer, however, will find useful information in the pages on carhouse design.

Section 3 is strictly technical, and contains a large number of formulas relative to train schedules, train resistance, acceleration, curvature compensation and kindred subjects. The author presents the indifferent with the good and leaves the reader to take his choice; for instance, in addition to ten train-resistance formulas, the uses of which are briefly explained, thirteen others are presented without comment.

As steam-railway electrification is in its infancy, the information on electric-locomotives and that on catenary construction is welcome. Because of this infancy it is especially desirable that the information should be up to date, and one notes with disappointment that the electric locomotive data are apparently five years old. The articulated type of engine in use on the New York Central for the last two years is not mentioned.

The mechanical work on the book is good. Type and cuts are clear, the index is ample and frequent bold-face sideheads make it easy in the main to find what one is looking for. The material is gleaned from numerous sources—books, technical journals and society findings—and the reviewer notices several instances aside from that of the electric locomotives where the author has failed to present the latest data available. As this is the first edition this is not strange, and doubtless these defects will be remedied with the next edition.

Tunneling

Author, Eugene Lauchli. Cloth, 6 x 9 in.; 238 pages, 197 illustrations. New York, McGraw-Hill Book Company, Inc. $3 net.

Reviewed by S. P. Brown

Chief Engineer, Mount Royal Tunnel and Terminal Company, Ltd., Montreal

This book, on the whole is good. In fact, the reviewer considers it probably the most important contribution to tunnel literature during the past decade. There is considerable waste material in it and even more opportunity for elaboration and addition. There are, perhaps, a few errors and typographical mistakes, but these are few considering that it is a first edition.

It must be remembered that Mr. Lauchli is not a man of leisure, but a busy man of affairs. To this must be charged the very great lack of detail and elaboration in many portions of the book, especially those dealing with the actual construction. His book, however, strikes the right note, dealing with the cardinal points of tunneling in just the way a tunnel digger likes and with the convincing certainty of a man who is intimately familiar with both the design and the construction phases of his subject.

It is a book that will be particularly appreciated by practical and experienced men. While it contains an enormous amount of concentrated information, showing well the time and labor required for its compilation, the direct simplicity of its style and the absolute absence of vacuous verbosity gives it a charm and impressiveness that are sadly lacking in ordinary works of this character. No experienced and practising tunnel engineer can afford to be without it, and even for the inexperienced it is valuable in its condensed information and in the guiding influence it will exert on his future development.

In the early part of the book a considerable amount of cost data is given, especially in tabulated form. This is something that the reviewer considers a regrettable habit which is becoming increasingly popular among the writers of books and magazine articles. Cost data, unless bulwarked with complete information regarding local conditions, is a dangerous kind of "knowledge" to spread about. The thoroughly experienced man is able to use it to a certain extent in comparison and by judicious eliminations but to one less discriminating such information is apt to prove a pitfall that may cost his employer very dearly. On the whole, however, there is less of this type of data than in many similar books, and, of course, such notes are always interesting, if nothing more.

Another weakness, which the reviewer fears will react detrimentally upon the sale and usefulness of the book, is the particular and exclusive mention made, both in the text and illustrations, of a single make of drill. The experienced man, if glancing through the book casually, might be inclined to cast it aside as an inspired article. The man who reads it carefully, if inexperienced, might either become prejudiced and fail to realize the true value of the work as a whole, or even be led to imagine that that make of equipment was a uniquely superior product. For the experienced man who really gets into the book, however, this shortcoming will carry no weight.

Chapter 1 deals with tunnel geology, and is well done. Too much stress cannot be laid on the importance of thorough geological surveys and studies in an important tunneling project before the work is commenced. Very few engineers are thoroughgoing geologists, being inclined to class rock simply as "rock," "hard rock" and "damned hard rock." The reviewer speaks from experience when he expresses his approval of the importance Mr. Lauchli has attached to this department, both in the beginning and in subsequent chapters.

The first six chapters, except perhaps Chapter 1, which is of a more general character, are devoted to construction details and are as full of information as an egg is of meat. Mr. Lauchli has evidently taken pains to become familiar with a great many tunnel works, both in America and abroad, and has used them to illustrate his points very effectively. The amount of space allotted to these chapters is very small, so that in merely reading the book casually one feels rather overwhelmed. In fact, when the reader sees matters of gravest importance disposed of in a single sentence, he begins to worry about similar "suggestions" that he may have missed, and will go back to read it through again in a more deeply pondering frame of mind. The book must be studied, not merely read. It is not to be perused for pleasure but requires solid conscientious work. The result of such work, however, is well worth the pains.

Commencing with Chapter 7 Mr. Lauchli enters upon his favorite theme. In the study of the engineering problems dealing with long and deeply overlaid tunnels he has spent years of serious and most exhaustive work. Here is his *chef d'oeuvre*. Chapter 7 deals in a general way with the driving of long and deeply overlaid tunnels. It discusses methods and questions of design, giving many most interesting references and bits of information. In certain respects it is one of the most interesting chapters in the book and shows Mr. Lauchli at his best.

Chapter 8 deals more in detail with methods and equipment and is good as far as it goes, but, in common with the earlier part of the book, is disappointing in its brevity.

Chapters 9 and 10 deal largely with the theory of ground pressure, timbering and lining. Here again Mr. Lauchli is in his element, although both his theories and references suffer from brevity. His effort to combine and modify the theories of some of the more radical and perhaps less practical geologists and engineers voices, the reviewer believes, the general view of most modern tunnel men, although the reviewer cannot entirely agree with some of the detail in his illustrations. These chapters are, however, very conspicuous contributions to our tunnel literature and very encouraging in their evident deep thought and serious study.

In Chapter 11 the very elusive and widely-argued question of rock temperature is discussed at some length. This is a problem that seldom assumes serious proportions except in very long and deeply overlaid tunnels and can hardly be dealt with satisfactorily in the space available. Mr. Lauchli has, however, done remarkably well and leaves the reader fully impressed with its importance without distorting its possible relation to ordinary tunnel work.

Chapters 12 and 13 relate to ventilation during construction. Both of these chapters are interesting and full of valuable data and information. They come in natural sequence after the treatise on rock temperature and form a very fitting finis to the portion of the book devoted to rock tunneling.

Chapter 14 briefly describes the various methods of soft ground tunneling with their respective systems of timbering. While this chapter is not long it is quite ample, being principally a review of well-recognized methods.

Chapter 15 deals with the theory of soft ground pressures and is a little too brief in parts. The formula selected is one of the best, but even at that it is only making the "best of a bad job." Computing probable pressures on tunnel lining is merely a very rough guide and, as Mr. Lauchli says, must be done discreetly and applied after adding a very substantial factor of safety. The examples quoted are interesting and well selected.

Chapter 16 deals with siphon tunnels and is discoursive and interesting. It particularly draws attention to the importance of the geological studies made in connection with the Catskill Aqueduct. These are probably the most elaborate ever made and are, without doubt, the most valuable in their results. The chapter is well devised.

Chapters 17 and 18 add but little to the book. The former, dealing with compressed air, is too brief to be particularly instructive, and the latter is merely description with nothing of unusual interest except, perhaps, the reference to the relining of the Mauvages Canal Tunnel where much ingenuity was exercised.

To conclude, the reviewer thinks that Mr. Lauchli is to be congratulated on his book and deserves great commendation and appreciation from the tunnel-building fraternity. The book is especially well written, not only in its choice of English, but in its direct simplicity of treatment. It is well indexed and arranged and is very tastefully presented. Above all it is a perfect mine of valuable facts and information, much of which is entirely new. The distribution of the book will be large and when Mr. Lauchli produces his next edition, which cannot come too soon, the reviewer predicts that it will be at least one of the most sought-after engineering books of its time.

LITERATURE ON WATER METERS AND WATERWORKS is provided in the employees' room of the Milwaukee water department so that those inclined to further their knowledge in their line may do so.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

A Natural Engineer

SIR: On a recent trip from Lawrence, Kan., to Kansas City, Mo., I shared my seat in the smoker with a ragged, rusty-complexioned coal miner from Leavenworth, Kan.

He admitted that an engineer had to know something, but that it was right that the tradesman should get the same wages, because he really knew how to do things and actually did do them. He said, "Say, do you know the big keystone in the brick arch over the entrance to the Old Soldiers' Home at Leavenworth?"

I remembered it and he wanted to know how I thought that it was placed there. When I gave up guessing, he said, "Me and a old man and a boy done it. There was a pile of boards alongside of the gate and when me and the boy lifted the stone a little, the old man shoved a board under it. We used up nearly the whole pile before we got the keystone high enough."

I claim that he is a natural engineer.

ROBERT S. BEARD.

Lawrence, Kan.

When Efficiency in Water-Power Design Is Overdone

SIR: Having read with profit the article by R. D. Johnson in your hydroelectric number of March 20, the description of the design for the Cohoes development in the same number and Mr. Johnson's letter in the issue of April 10, page 467, pointing out the need for highly specialized engineering in water-power design, the writer ventures to suggest that there are practical limits, of course, to refinements in the method of handling the strictly hydraulic features of design, and that capitalizing the probable increase in efficiency seems to be the shortest method of determining where the line shall be drawn.

Undoubtedly engineers should and do consider every possible agency for the fullest use of the available water, but the older and less expensive style of construction, as against the most up-to-date design, will frequently show the best returns on the capital investment. It would seem to be safe practice to apply the test by estimating cost of development by both methods, valuing the increased power obtained from the most modern design and then capitalizing this value to show whether the more expensive type will justify the increase in construction cost. Instances have occurred where such expensive items as concrete draft tubes cannot be justified when the above-mentioned test is applied, more particularly when their discharge is subject to wide variations due to fluctuations in load.

Industrial engineers are constantly having problems put up to them to put losing hydraulic power propositions into the winning column, and usually by capitalists who demand results of a financially satisfactory nature only.

Mr. Johnson points out a field of work, heretofore insufficiently considered, in which increased earnings can be developed in most of the earlier and some of the later hydraulic power plants.

The reference to the Cohoes development is made only to point out the carefully designed draft tubes, of a necessarily expensive construction, which may pay the highest kind of dividends in this instance, but when applied to some other situation might not justify the increased cost.

As to the editorial comment relating to turbine efficiency and qualifying Mr. Johnson's statement; undoubtedly the point is well taken, but it is equally certain that Mr. Johnson recognized, or intended to recognize, the improvement in turbine efficiencies, and was thinking of the possibilities of improving penstock, draft tube and tailrace design.

WM. H. CUSHMAN,
Constructing Engineer.

Scotia, N. Y.

Repair of Concrete Buildings at Edison Plant

SIR: Your issue of April 17 has just been received, and, while I have not had a chance to read the article on page 503 on the Edison fire, I have glanced over the same.

I have been interested in your statement with regard to cost of the work, which I presume you have obtained from an authoritative source. I also note that you say that the term "reinforcement" is used, although no additional strength was given by the repairs. Perhaps that statement may be misunderstood. Likewise, with reference to the report of the test in Building 11, you mention a deflection of 13/64 in. under 300-lb. test load. This was the approximate deflection in these panels before repairs were made, but according to the test made under the direction of the American Concrete Institute the maximum deflection in these two panels after repairs had been made was 5/64 in. for 300-lb. load, as against a maximum deflection before repairs, with same test load, of 16/64 in.

You speak of a floor test on the repaired section of Building 13 loaded to 400 lb. per square foot, with a resulting maximum deflection of 5/32 in. This must be a test made since I left Orange. I wonder if this test you speak of as being made on repaired section of Building 13 was not made on the repaired section of Building 15, the panels of which are of the same size. The maximum deflections of the unrepaired panels in Building 15 for 300-lb. test loads was 15/32 in., and if a deflection of but 5/32 in. under 400 lb., or 3/32 in. under 300 lb. per square foot was obtained after repairs, the result was certainly very satisfactory.

It should be borne in mind in connection with these test records that shoring was in place under the girders when the tests were made before repairs, leaving the floorbeams free to deflect between girders but probably preventing deflection of the girders themselves. These shores were all removed after the repairs had been made, so that while the tests were being made after repairs the girders as well as the floorbeams were free to deflect. It is interesting to note that the deflection of the girder in the test on Building 11 after repairs was nearly as great as the deflection of the floorbeams which connected to and were supported by the girder.

The tests after repairs were being made under the direction and observation of a committee of the American Concrete Institute, and doubtless their report will contain exact information with regard to the tests.

To me it seems very evident that the repairs not only replaced the fireproofing that spalled off during the fire but also *materially strengthened* the floors that had been injured by fire. The object of these repairs was to restore the buildings to their original strength, and it is gratifying to see that this has been accomplished.

T. L. CONDRON.

Chicago.

Why Not a Rational Specification for a Wooden Pile?

SIR: The typical specification for a wooden pile, as used by most railroads, municipalities, etc., and as advocated by most producers, reads about as follows: The pile shall be so straight that a line stretched from center of butt to center of point will not leave the pile more than 1/100 (for example) of the length of the pile.

Several criticisms instantly arise in one's mind as to this specification.

1. It is obviously impossible to stretch a line from center of butt to center of point; and therefore a substitute method has to be employed, which latter should logically also be substituted in the specification. Obviously the pile will naturally lie on a flat surface so that its greatest curvature is horizontal. A line is then stretched from the butt to the point over the centers of each; and, by sighting down vertically along the string, the distance between the projection of the string and the side of pile is noted.

2. What relations should exist, if any, between the crookedness of a pile and its length? Obviously, again, the pile must be near enough straight to be placed in the pile driver. It also must not be so crooked that a blow of the hammer will bend it so as to damage it; and it must not be so crooked that its final load will produce a bending moment in the pile so large in amount as to produce stresses exceeding a safe maximum. This load condition and the phenomena during driving are practically identical in nature, except that one is static and the other dynamic. The theory of bent columns, or what is the same thing, of eccentrically loaded columns, or of arches, must of necessity apply to piles.

Again, it is obvious that with relation to members of the general size and shape of piles, the length has no effect on the stresses due to eccentricity of loading at any section, the latter being due only to the amount of the eccentricity and the area of the corresponding section.

3. What should be the maximum permissible crookedness? It would seem that it should depend upon the permissible maximum bending stress for the material composing the pile and of the area of the latter. Most engineers would doubtless concede a relatively high unit stress as permissible for the condition of combined direct stress

and bending of a pile. From this it is seen that when all piles are designed to be uniformly loaded when finally in place, a greater bend is permissible in a pile of large diameter than in a smaller one, because a less unit direct stress will exist in the large pile and a greater one due to the eccentricity of load may be allowed. Such a specification may not make inspection easy and may possibly be considered impracticable for other reasons, but its logical possibility is evident.

Of course different kinds of wood must have different permissible bends. Also, the designer's load per pile will influence the allowable bend, if the limit placed on the total maximum unit stress is constant.

Assume, for example, a 12-in. round pile; area where bearing on soil begins, 100 sq. in.; designed loading per pile, 15 tons or 30,000 lb. Then the direct stress per square inch is 300 lb. If a safe total unit stress of combined compression and bending of 2400 lb. is assumed (the recommendations of the committee on wooden bridges and trestles of the American Railway Engineering Association, for longleaf pine are 3800 ultimate stress, 1300 safe stress, 1300 $(1-l/60D)$ for long columns, 6500 ultimate for extreme bending, 1300 safe) then 2100 lb. may roughly be assumed as the maximum permissible bending stress due to eccentricity of load at the section. Since the moment of inertia is about 1016.164 and the section modulus is 169.364, the maximum permissible eccentricity of stress at the ground level would be 11.9 in. Again at a point approximately 8 in. in diameter where the total direct stress may have been reduced by half, with an area of about 50 sq. in., the permissible bending stress may be assumed at 2250 lb. The moment of inertia is 196.704, the section modulus 49.176 and the permissible eccentricity 7.4.

Examples might be multiplied; but it seems evident from the two given that a modification in the type of specification now in use might be advantageous. It seems obvious that the permissible bend should not be measured in terms of the length of the pile, but rather in terms of its diameter at each point along its length. With this idea in view, the following wording with reference to yellow-pine piles is submitted for criticism:

"The pile shall be so straight that a line held in contact with any two points selected so as to give the maximum deviation shall not be distant from the surface of the pile at any point more than the diameter of the pile opposite that point."

E. P. GOODRICH,
Consulting Engineer, Department of Public Works, Borough of Manhattan.
New York City.

[Mr. Goodrich has raised some interesting points and discussion is solicited.—EDITOR.]

Concrete Bleachers to Protect Massachusetts Shore

SIR: On page 429 of the Engineering Record of April 3 is an article entitled "Concrete 'Bleachers' Protect Massachusetts Shore." This article describes the first application in this country of the ramp principle to structures for shore protection.

It will be of interest to note how long this revetment will withstand the bombardment of storms. That it will prove more permanent than wooden piles or bulkheads is not so absolutely certain. The forces exerted by waves are many and cannot at this time be calculated. There is not only the impact in a horizontal direction, when a wave hits an obstruction, but there are also upward forces due to suction and the change in direction of travel, as well as powerful eddies. It is well nigh impossible to determine with certainty all the different forces, their magnitudes and directions, that a sea wall or other kind of shore protection is called upon to withstand.

When a wave recedes, another set of forces is created, all of which are different from those created by the blow of the wave. While in the first case the general tendency is to push the works further inland and at the same time lift them up in a nearly vertical direction, the tendency in the second case is to pull them out to sea.

In general, three main requirements must be considered: (a) Under cutting and washouts at the toe of the works; (b) strength to withstand the blow, and (c) anchorages to prevent the lifting of the works.

In view of the importance of shore protection works, it would be of interest to discuss the features of the "bleachers" at Boston. In the opinion of the writer, the toe wall has not been well protected against undercutting. A strip at least 15 ft. in width in front of it should be heavily riprapped to prevent the eddies and the undertow from washing out the sand. If this sand is permitted to wash out, the waves will soon be able to get hold of the part of the toe wall in front of the sheet piling.

It furthermore appears as if the "bleachers" had not been sufficiently anchored to prevent uplift due to suction, but if found necessary, such anchors could easily be provided later on. Such anchors should extend at least 12 ft. down into the sand in a direction normal to the slope of the concrete sills.

When a wave hits the "bleachers" its direction of travel is changed, and it will continue up the slope. The steps, therefore, would have been more effective had the risers been normal to the slope instead of vertical. When, on the other hand, the wave recedes, its hold on the concrete would have been somewhat lessened had the treads been given a steeper slope than 1:36.

Protection works of this kind have been described in German technical literature. In the "Beton Kalender, 1908," Part II, page 322, there are two illustrations and a brief description of such works.

Professor Max Moeller, of the Technical University in Braunschweig, in his book "Grundriss des Wasserbaues," Edition of 1906, Part II, page 531, mentions a similar type of shore protection patented by him. In his type, however, there are no steps, but the reinforced-concrete deck has been given a rough surface by projecting parts. Professor Moeller's book is very interesting because of numerous photographs showing different types of shore protection in course of construction, after they have been finished, and after a heavy storm. Although most of the works are anchored, the waves have in many cases pulled off the concrete decks, leaving the reinforcement of the anchors projecting above the sand. This shows that the anchoring feature is of the utmost importance and should be detailed with considerable forethought.

A. G. HILLBERG,
Wegmann & Hillberg, Consulting Engineers.
New York City.

[A copy of this letter was sent to John R. Rablin, engineer of the Metropolitan Park Commission of Boston, who designed the structure. Dr. E. L. Corthell, author of "The War Against the Waves," which appeared in the Engineering Record of April 11, 1914, page 408, and a recognized authority on the subject, was also asked to comment on the letter. Their comments follow.—EDITOR.]

SIR: In reply to the criticisms of the design in Mr. Hillberg's communication, made under the headings of the three main requirements which should be considered, (a) under cutting and washouts at the toe of the works, (b) strength to withstand the blow, and (c) anchorages to prevent the lifting of the works, I would say that the toe wall has been designed of such depth that its base is considerably below the lowest elevation to which the beach has ever been eroded by storm and, judging from the general contour of the beach from the toe wall out beyond mean low water, there is little danger of its ever washing out to the base of the wall. The addition of the sheet piling underneath the toe wall was for a further protection against undermining, provided the beach should reach so low an elevation at any point.

Regarding the strength to withstand the blows of the waves, we are satisfied that we have provided sufficiently.

The possibility of damage by uplift due to suction was not considered important in this case, on account of the fact that the structure is at such an elevation above mean high water that the volume of water deposited upon it in times of storm is not of such amount as to cause excessive suction upon its return.

The works at Revere Beach were completed last fall and have passed through a winter with many of the most severe storms of late years with no damage. The surface of the beach at the toe wall has remained generally about at the top of the toe wall, and in some places it has been washed up over the lower part of the structure, covering it entirely with sand and shingle. Formerly the tendency of storms has been to lower the beach generally.

JOHN R. RABLIN,
Engineer, Metropolitan Park Commission.
Boston.

SIR: The storm servitudes along Revere Beach require, at the point where these concrete steps have been built, very substantial construction and the least possible obstacles to the movement of the waves. If the work built there and shown in the Engineering Record is solidly constructed and in a workmanlike manner and on a stable foundation, it will be likely to stand intact. The tide in this part of Massachusetts Bay rises about 9 ft. and in onshore storms still higher. It is a question whether with a 10 or 12-ft. storm tide the waves will not overtop the crest of the work.

All engineers interested in shore protection will watch the maintenance of this structure. If it should maintain itself under repeated and violent onshore storms, it will no doubt be applied elsewhere under similar conditions. It is therefore to be hoped that Mr. Rablin will, from time to time, give the profession a record of this work.

E. L. CORTHELL,
North Egremont, Mass.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

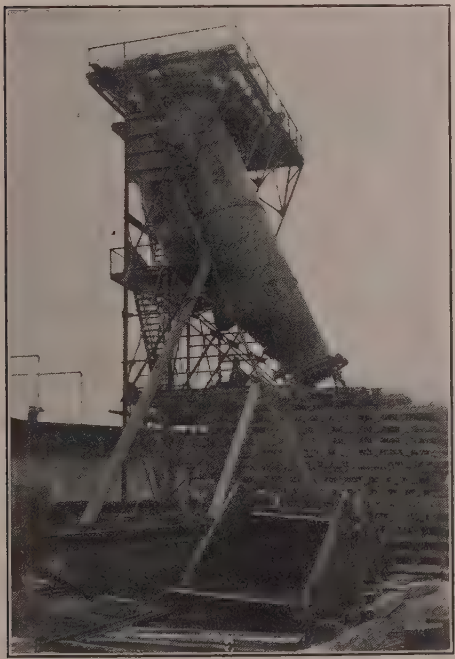
Unwieldy Tanks Are Raised to Steel Supports at Wood Block Plant

By F. M. BIERSACH

Erection Superintendent, Allis-Chalmers Manufacturing Company

TWO large irregular shaped tanks for treating paving blocks at the plant of the Ayer & Lord Tie Company at Carbondale, Ill., were recently raised with tackles hooked to the steel frames previously erected to hold the tanks.

Each of these unwieldy tanks practically required three points of supports to control its movements until nearly in place. Each was first rolled from the flat car on which it was loaded on to a high crib of ties, and turned 90 deg. with its top resting at the foot of the tower. Two main falls, handled on winch heads of a hoist, were attached one to each side of the top of the tank. The tail, which had to travel over the cribbing as the tank rose, was carried on a cradle riding on wood rollers till it neared the base of the tower. After this point was reached a snub line kept the tail from swinging in too fast toward the tower. As the tank was raised, however, cribbing was built up and the tail allowed to slide on it as a precaution in case something should break.



FIRST TANK CLOSE TO FINAL POSITION

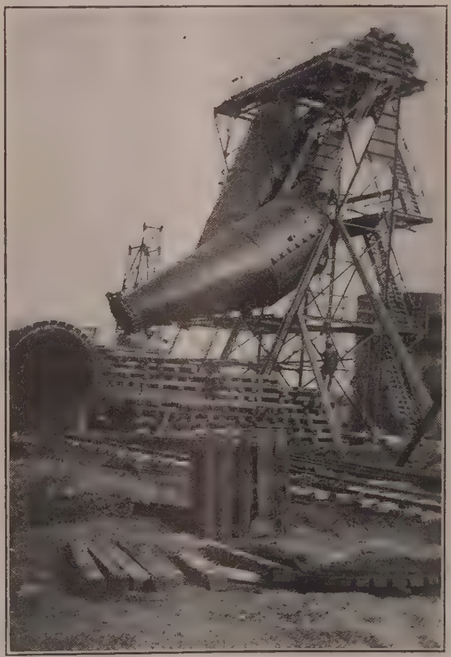
The cribbing was high, and had to be carefully built. After each tank had been raised within a few feet of its final position the lifting hitches had to be transferred to the flanged connections shown on the sides of the main barrel to complete the raising. This erection was done by the writer for the Allis-Chalmers Manufacturing Company, which furnished the tanks.

Engineer Tells How to Make Tractor Hauling More Profitable

THAT TRACTOR hauling would be much more economical if small wagons were used, enabling one tractor to haul a great number of light units, and increase the tonnage hauled with a lowering of the cost per ton mile, is the conclusion reached by Fred Tarrant, division engineer, in the April bulletin of the Illinois Highway Department. It is pointed out that with the heavy units, delays are often caused by bad spots in the road. With the smaller units, Mr. Tarrant states that a smaller load comes on the bad spot at one time, and the engine is able to pull the load through without any trouble. If heavy equipment is to be used in hauling, the roads will have to be designed to take care of that kind of traffic, otherwise the maintenance of these roads will be enormous.

To Hold Sod Until It Takes Root

THE accompanying photograph shows how sod is held in place on a $1\frac{1}{2}:1$ slope on new embankments in connection with the Welland Ship Canal. The particular slope illustrated is on the section of the Grand Trunk Railway, at Thorold, which was relocated in order to make way for the ship canal. The pegs are $\frac{3}{4}$ x 1 in. in cross-section and about 6 in. long, sharpened at one end. One is driven in each sod to a depth merely sufficient to hold it on the embankment until it takes root. By leaving the pegs projecting, as shown, they can readily be removed when desired. As a matter of fact, many of them are forced out by frost the first winter after the sod has been placed.



TAIL OF TANK ON CRADLE AND ROLLERS

PEGS HOLD SOD ON STEEP CANAL BANK

The Welland Canal work is being carried on under the direction of J. L. Weller, engineer in charge.

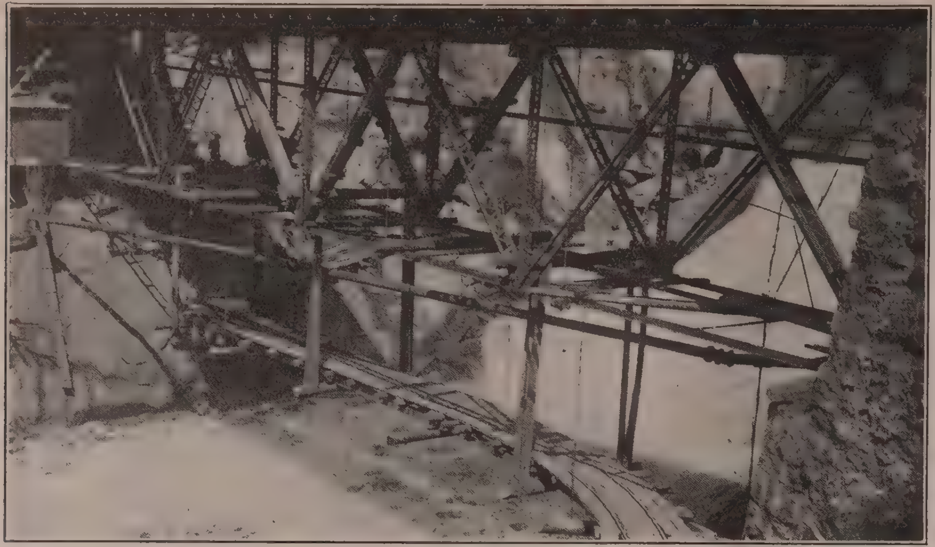
Electric Welding Saves Lapping Steel for Power Conduit

ELECTRIC welding at a central plant expedited the fabrication of the steel hoop reinforcement used on a long concrete conduit for the Deerfield River power development at Hoosac Tunnel, Mass. The bars were bent over into the required shape and their butts were electrically welded. It was found in the final summing up that the saving in steel alone, obtained by doing away with the necessity of lapping these bars, as is the common practice, went a great way toward paying for the expense of the shop work. The expense saved in the field by eliminating the labor necessary to do the bending there and in the wiring together of the lapped ends was not accurately determined, but a concrete man can readily appreciate that it must have been considerable. Tests made on these hoops showed the welded sections to be the strongest parts of the hoops, due to the fact that there was naturally a greater area of cross-section at this point. The work was done by the Power Construction Company of Shelburne Falls, Mass.

Contractor's Railroad Suspended from Highway Bridge at River

A CONTRACTOR'S railroad was carried across the Deerfield River cheaply by suspending the cross-pieces that supported its track girders from the chords of an existing highway bridge. This bridge, in itself, did not have deck space sufficient to accommodate both the railroad and the traffic for which it had been built, and a trestle, besides being much more costly, would have been in constant danger of being carried away, as the river is subject to very destructive floods.

The highway bridge is of the Warren triangular truss type and was situated near



TEMPORARY CONSTRUCTION TRACK SWUNG FROM EXISTING HIGHWAY BRIDGE

the upper end of the job. Round timber cross-pieces were laid resting on its lower chords and were given further support by round iron rods suspended from the floorbeams of its deck. From these, other iron bars were dropped and the lower cross-pieces were hung on to them. The latter provided support for the squared girders that carried the tracks. Additional stability was gained and the temporary structure stiffened by placing other cross-pieces in the lower chord joints and suspending the lower cross-pieces from them by means of planks. This structure was built by the Power Construction Company of Shelburne Falls, Mass., and was used by them for a short time, on a construction job in connection with the Deerfield River power development project.

Pipe Connecting Meters to Main Jetted Under Expensive Pavement

By M. L. KAUFMAN
Los Angeles

IN ORDER to avoid cutting trenches in an expensive pavement recently laid on the Franklin Turnpike in the Borough of Allendale, N. J., where connections were to be made on the opposite side of the road from the water main, the connecting pipe was jetted through horizontally under the pavement with the 50-lb. water pressure from the main. A pit was first dug large enough for a man to work in with a short length of pipe where the box for the new connection was to be located. Water was carried to this pit from a corporation cock in the main through a heavy hose. On the end of this hose was attached an ordinary stop cock, into which was screwed the first 5-ft. length of pipe to be jetted. This pipe would be jetted in, uncoupled from the stop cock, and another length inserted. It was found possible to drive the pipe very close to line. The threads on the driving end of the pipe could, of course, be protected by a sleeve. It was necessary to keep one man busy bailing out the pit with a small hand pump.

Although the ground under the highway was compact gravel with occasional boulders no difficulty was found in connecting any of these branches to the main. The hose was stout enough to stand being run over by ordinary vehicles, but when a heavy truck came along it had to be temporarily removed. The two men ordinarily employed could jet a pipe line through and connect it in less time than it would have taken a larger gang to dig up the pavement and lay the pipe in a trench.

This scheme was originated by B. F. Hutches, commissioner of public works of the borough, and was carried out by the writer, as engineer, with day labor.

Special Castings Grip Columns Underpinned for Subway Work

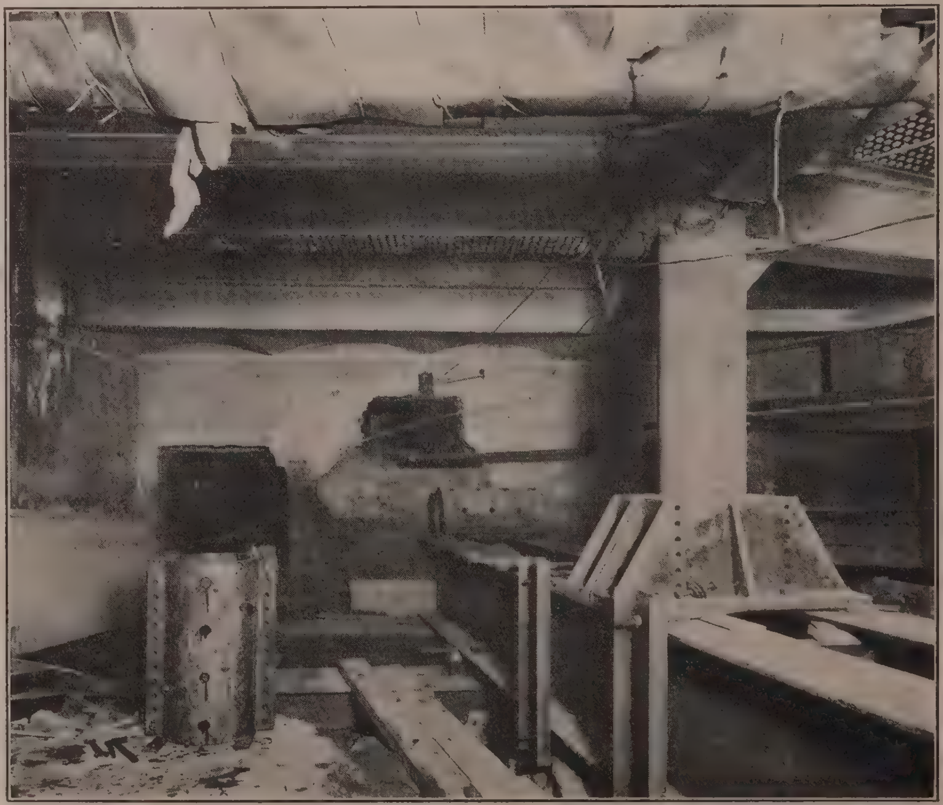
GETTING a grip on two 16-in. diameter cast-iron columns carrying a load of 300 tons each under the Baudine Building at Broadway and Twenty-eighth Street, New York, required heavy special steel castings. These columns had to be supported while their footings were carried to a safe depth, and the general scheme adopted was similar to that used at the Centurian Building by the same contractor, and described in the Engineering Record of May 1, 1915, page 565.

A cast-steel base with a milled top was built in two sections, set on top of the girder beams, and bolted around the columns. It is shown in place in the photograph. Above it and bearing on it was set the two-piece cast-steel jacket shown at the left of the view. This jacket was drilled for ten 2-in. pins passing through the column. It was turned out to size inside, set up and matched on the ground, and then plastered inside with iron cement and bolted around the column. Holes were then drilled through the column, using the jacket as a template, and the pins driven home.

This work is being done by the United States Realty & Improvement Company, contractors for Section 2 of routes 4 and 36, for whom C. H. Stengel is chief engineer, E. A. Little, general superintendent, and S. S. Jones, field superintendent. For the Public Service Commission, Edward Pendlebury is section engineer, and J. O. Shipman, engineer on the first division.

Rust-Proof Joint Where Steel Enters Concrete Base

IN ORDER to keep the steel legs of transmission towers from rusting off where they enter the concrete base, the construction department of the Ohio Light & Power Company has originated a novel scheme for waterproofing this vulnerable point. While the concrete is still green small trenches 2 or 3 in. deep are dug into it at the base of each leg, and the surface of the steel carefully cleaned of concrete. After the base has set, these trenches are filled with an asphalt compound, mixed so that it will not crack in cold weather and will not melt in a hot sun. If care is taken in pouring these joints, they can be made so tight that water cannot collect in them against the surface of the steel.



JACKET AT LEFT MADE TO GRIP CAST-IRON COLUMN CARRYING 300-TON LOAD

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

General Celebrations Mark Formal Opening of Dalles-Celilo Canal

A series of celebrations and festivities lasting an entire week was staged throughout the Columbia River Basin during the dedication and formal opening of the Dalles-Celilo Canal. A fleet of river boats passed down from Lewiston to Astoria, touching at intermediate points on the way and participating in the celebrations, which included barbecues, parades and speeches by pioneer navigators and by men prominent in political, professional and business life.

The Dalles-Celilo Canal was described in detail in the Engineering Record of March 14, 1914, page 296. Water was first admitted to it for test purposes on April 7 and was allowed to remain for about a week. Some few slight leaks developed in the concrete lining and had to be repaired. On April 20 it was again filled and on April 28 the first boats were passed; one bound downstream for Portland and the other upstream for Lewiston. The canal opens the river to light draft vessels as far upstream as Priest Rapids on the main river above Pasco, and to Lewiston on the Snake River, the latter point being 500 miles from the Pacific. It is about 8½ miles in length and overcomes a fall varying from about 82 ft. at low water to 45 ft. at high water. The cost of the work was almost $5,000,000.

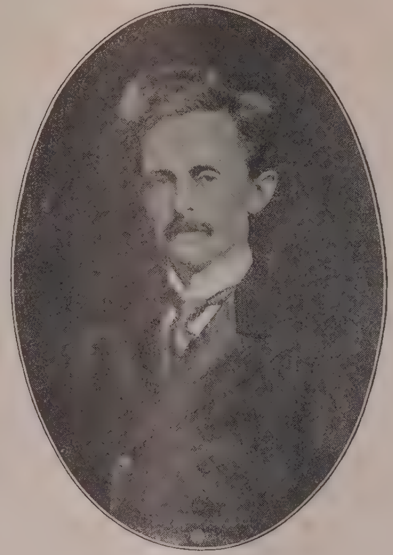
Completion of Lock 17 Makes Warrior River Navigable

On May 13, almost simultaneously with the opening of the Dalles-Celilo Canal in the extreme Northwest came the celebration in the Southeast of the completion of another extensive canalization project, the improvement of the Warrior River in Alabama. By the completion of Lock 17, below the junction of the Mulberry and Locust forks, navigation is brought 500 miles to the mineral district around Birmingham. The improvement is stated to have cost $11,000,000.

Pennsylvania Law Holds Individual Responsible for Fire Damage

The Governor of Pennsylvania has signed a bill which fixes upon individuals and corporations financial responsibility for damage and expense caused by fires due to negligence or violation of fire laws and ordinances. This law resembles the New York State law, in existence for many years, but a dead letter until New York City recently brought a case against the Greenwood Cemetery Company and established a precedent of such value, at least, that one offender has already paid a bill rendered him for the cost of putting out a fire.

Head of Pearson Engineering Corporation, Ltd., Who Was Lost with the Lusitania



FRED STARK PEARSON

Silting to Be Tried at Cedar River Dam

The majority of members of the city utilities committee of the City Council, Seattle, on May 4, approved a resolution directing the board of public works to make plans and specifications for silting the new masonry dam at Cedar Falls, in an effort to prevent seepage. In so doing the committee went over the head of City Engineer A. H. Dimock, who recommended to the council an appropriation of $25,000 to cover the cost of drilling more test pits in the north bank of the Cedar River to ascertain if a curtain or wing wall is feasible.

Three American Engineers Lost in Lusitania Disaster

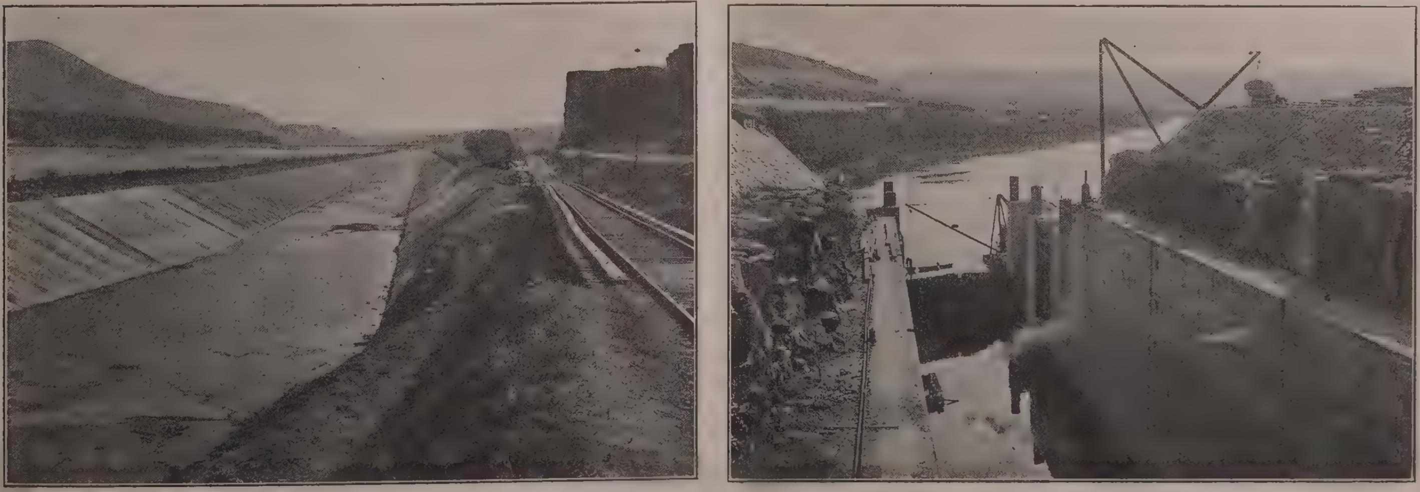
Dr. F. S. Pearson, A. L. Hopkins and Lindon Bates, Jr., on Torpedoed Cunard Liner

The sinking of the Lusitania, May 7, caused the death of at least three American engineers —Dr. F. S. Pearson, consulting engineer, of New York, and one of the leaders in the field of foreign hydroelectric development; Lindon Bates, Jr., consulting engineer and author of works of a technical nature, and Albert L. Hopkins, a civil engineer and president of the Newport News Shipbuilding Company. It is supposed that Scott Turner, a civil engineer of Lansing, Mich., was also lost, as nothing has been heard from him and he is supposed to have boarded the ship at the last moment.

Dr. Pearson and Mr. Hopkins were crossing to Europe on business along their respective lines. Nothing is known of their actions from the moment the ship was struck to the time she went down. Mr. Bates' trip was in connection with the work of the Commission for Relief in Belgium, of which his father is vice-chairman, as noted in this journal, April 24, page 538. Soon after the ship was struck he went below in a vain effort to find the children of some friends and returned to the deck shortly before the boats pulled away. When last seen he was standing on the deck, having just given to a woman passenger the life belt with which he had provided himself.

Dr. F. S. Pearson

Dr. F. S. Pearson was born and educated in this country and developed from here the beginnings of his large engineering business, which came to be international in scope. Although he still kept a home at Great Barrington, Mass., where he had an estate of 12,000 acres, much of his time for the last few years had been spent in England, where he had homes in Surrey and in London. It was necessary for him to be in England a great deal because of the large English interest in properties with which he was connected in Mexico, South America and Spain. Until Dr. Pearson arrived here in April he had been in this country for two years. One of the objects of his trip was to consider plans for the Denver & Salt Lake Railroad, of which he was chairman of the board of directors. The improvements contemplated for that property include electrification, or the construction of an extensive tunnel or a combination of inclined railroads and tunnels for use during the next few years until easier money condi-



COMPLETED DALLES-CELILO CANAL OPENS WATERWAY FROM PACIFIC OCEAN TO LEWISTON, IDAHO, 500 MILES INLAND tions permit the electrification which is desired eventually. Dr. Pearson was returning to Europe to meet security holders of the Barcelona Traction Light & Power Company, Ltd., and make final arrangements to continue construction. This company has completed one of its large power plants and the transmission lines and is in partial operation. It has constructed canals, dams and other hydraulic works, and the future developments outlined are to reach as large a total as the combined output of the plants at Niagara.

Dr. Pearson was born at Lowell, Mass., on July 3, 1861. He was graduated from Tufts College. In 1879 and 1880 he was instructor of chemistry at the Massachusetts Institute of Technology. From 1883 to 1886 he was instructor in mathematics and applied mechanics at Tufts. For the following two years he was a mining engineer, operating in the United States and Brazil. In 1888 he was manager of the Somerville (Mass.) Electric Light Company and later served successively as chief engineer of the West End Street Railway of Boston, the Dominion Coal Company and the Metropolitan Street Railway of New York. During his service with the last named company he constructed the underground conduit system. The wide extent of Dr. Pearson's later enterprises is shown by the fact that he was president and a director of the Mexico Tramways Company, the Mexican Light & Power Company, Ltd., the Mexico North Western Railway Company, the Rio de Janeiro Tramway, Light & Power Company, and the Barcelona Traction, Light & Power Company, Ltd. He was also a director of the Sao Paulo Tramway, Light & Power Company. Dr. Pearson was a member, among other societies, of the Institution of Civil Engineers of London and of the American Society of Civil Engineers.

Albert L. Hopkins

Albert L. Hopkins was graduated from Rensselaer Polytechnic Institute in 1892 and served for a few months as draftsman in the offices of Holabird & Roche, architects, of Chicago. In November of that year he was appointed computer and estimator in the Bureau of Construction and Repair of the Navy Department at Washington, D. C., which position he held for eighteen months. In 1894 he was transferred to the office of the superintending constructor at Newport News, where he was stationed until 1897, when he was assigned to the Graduate School of Naval Architecture at the U. S. Naval Academy, Annapolis, as instructor and lecturer on naval architecture and ship construction.

At the outbreak of the Spanish-American War in 1898 the officers and students of this school joined the fleet and Mr. Hopkins was assigned to the naval station at Key West, where he had charge of all the construction and repair work done for the blockading fleet operating in Cuban waters. In August of that year he entered the service of the Newport News Shipbuilding Company as personal assistant to the general superintendent of the shipyard. In 1909 he was appointed assistant general manager of the company and, in 1911, manager. He was elected vice-president and chief executive officer of the company in 1912 and president in 1914.

Lindon Bates, Jr.

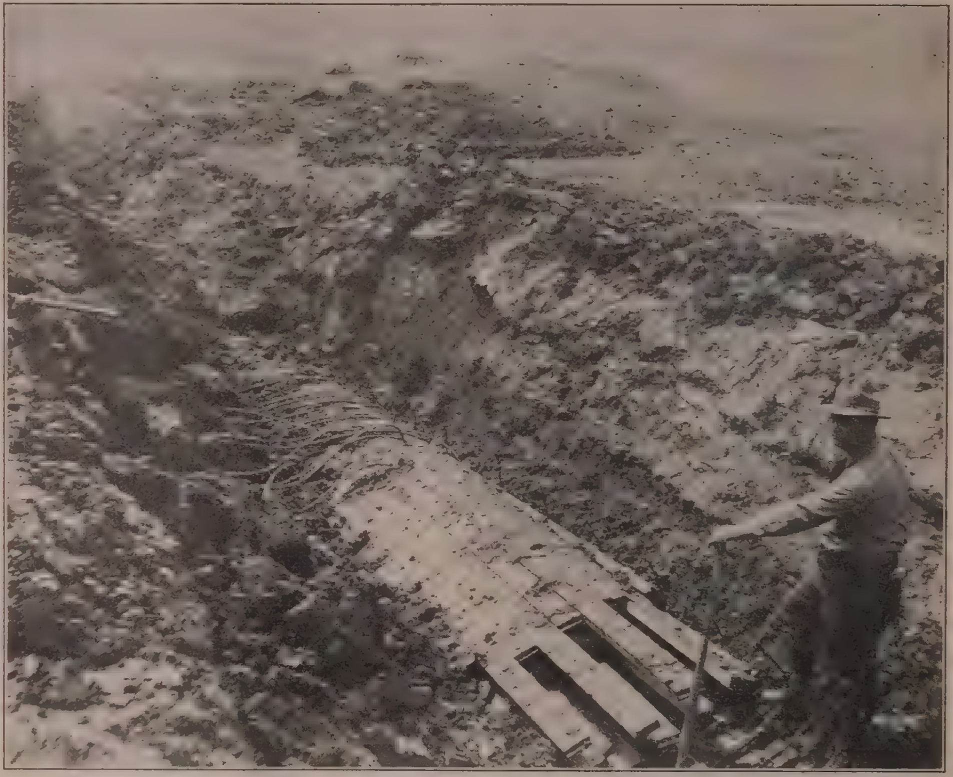
Lindon Bates, Jr., was graduated from Sheffield Scientific School, Yale University, in 1902, and after a year spent in post-graduate work in mining engineering became associated with his father in preparing estimates and bids for dredging work in Bengal, India. In 1904 he became vice-president of the United States Engineering Company and made a study of the canal site on the Isthmus of Panama. In 1905 he represented Goedhart & Bates at Galveston on raising the grade of 2 sq. miles of that city and, in 1906, became connected with the Empire Engineering Corporation as assistant superintendent on New York State Barge Canal work. After a short interval he was promoted to the position of assistant to the president of the corporation and had general oversight of all its work. He was the author of several technical works and papers, among them being "The Loss of Water in New York's Distribution System," published in 1909, and "The Russian Road to China," published in 1910.

Wood-Stave Siphon Collapses on Belle-Fourche Project

By EDWARD A. SMITH

U. S. Reclamation Service, Newell, S. D.

An investigation last month of excess seepage in the region of the Deer Creek wood-stave siphon on the Belle Fourche project of the U. S. Reclamation Service revealed the collapse of about 500 ft. of the pipe. For 100 ft. each way it was found to be badly distorted, the horizontal diameter being increased about 1 ft.


DEER CREEK WOOD-STAVE SIPHON COLLAPSES FOR A DISTANCE OF 500 FEET

The siphon, built in the fall of 1914, was on one of the important laterals. It was 60 in. in diameter and 1750 ft. long and, with a difference of elevation of 6 ft., carried about 150 sec.-ft. The staves were 2⅛-in. Douglas fir from 10 to 16 ft. in length. The banding consisted of ⅝-in. rods spaced 10 in. center to center. The excavation and laying were done in favorable weather but snow fell and drifted when the backfilling was about half finished and was not removed. The pipe was covered about 2 ft. for its whole length and the greatest head was 25 ft. The pipe had been tested before backfilling and no leaks were observed. Close inspection was given the staves and the construction. The soil is Pierre clay or gumbo.

The lateral supplied an area which was about to be opened for settlement and repair was begun at once. Almost all of the staves and bands were recovered in good condition. On re-excavation the trench showed about 8 in. of snow and it was noticed that the snow was found where the pipe had failed. The backfilling is being well tamped. It is expected that the siphon will be ready for service about June 1.

It is believed that the failure was from outward pressure. Although the pipe was full in the late fall it is thought that a leak developed which drained it. The presence of snow all along the collapsed portion probably has a close connection with the cause of failure. The collapsed section began at Sta. 5 at a quite decided change of grade.

Goethals to Speak at Johns Hopkins Dedication

Major-General Goethals, U. S. A., will speak at the dedication of the new engineering building at Johns Hopkins University, in Baltimore, May 21.

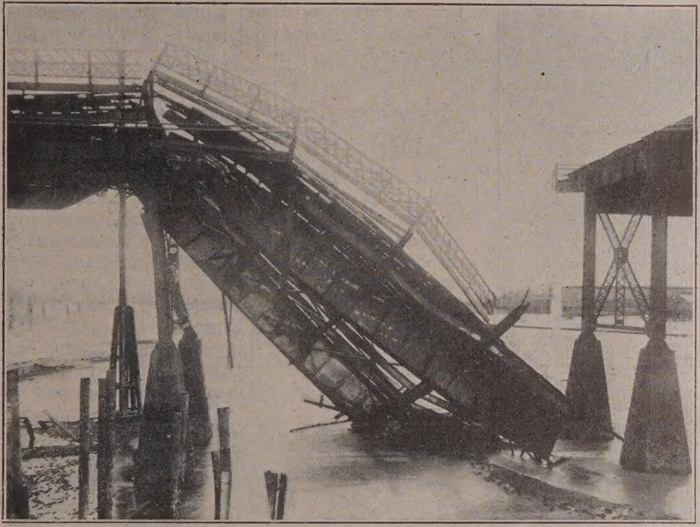
Way Cleared for Marginal Railway at Jersey City

Legislation has been put through which will permit Jersey City to build a marginal railway connecting all of the trunk-line railroads entering the city. This has been accomplished since January, when F. Van Z. Lane, consulting engineer, New York City, made a preliminary report on the subject to the Jersey City Chamber of Commerce. Mr. Lane states that the parties affected by the project are practically unanimous in support of it, and that he fully expects construction to be started this summer.

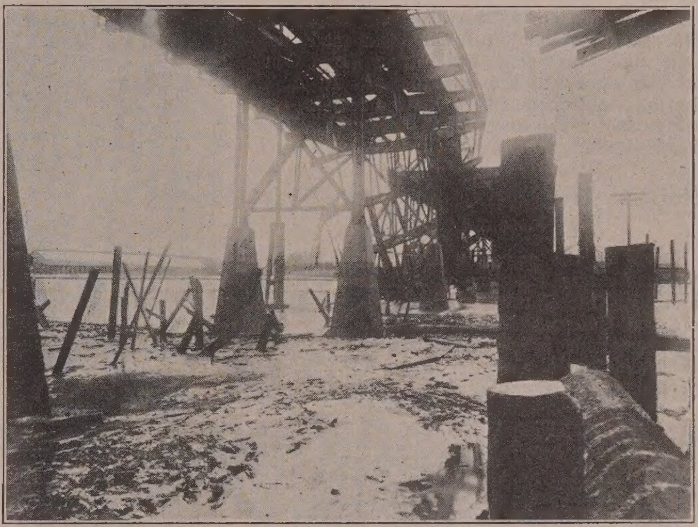
Briefly, the plan is for the city to build a low-priced belt line as near the waterfront as possible. If, as is expected, a private corporation will undertake to operate the road the city will lease it; otherwise the city will operate it. In order to keep the cost down it is proposed to occupy the city streets at grade. Electricity or some other comparatively inoffensive motive power will be used. The road is for purely industrial and local purposes, and is in no way intended to replace the general yards of the individual railroads.

The law recently passed by the New Jersey Legislature allows the city to spend $500,000 per year in the construction of the road. The total estimated cost is $1,500,000, but it is considered entirely feasible to build the line in sections. The next step to be taken is to submit a definite route to the Board of Public Utility Commissioners. It will also be necessary to submit to that body details as to the type of construction and the financial plan.

Mr. Lane thinks the route cannot deviate much from that shown in his preliminary report, which is as follows: Beginning at a point on the New Jersey Junction Railroad (a part of the New York Central system) between the Delaware, Lackawanna & Western and the Erie Railroads, this being the only point where the New Jersey Junction is at grade, the line runs east to Henderson Street, the last street not broken up by railroad yards; continues south on Henderson Street to First Street, where it swings east to Warren Street to afford a better crossing with Montgomery Street, the city's main business street; turns west along the Morris Canal, and finally swings back to the south and east to a junction with the Central Railroad of New Jersey at Claremont Station. Several branches are contemplated, including one to the only city-owned dock, at Morgan Street.



FIRE WRECKS ONE SPAN OF CONNAUGHT BRIDGE



FLOOR AND PAVING OF CONNAUGHT BRIDGE IN FLAMES

Mayor Vetoes Lockwood-Ellenbogen Bill on Building Inspection

Mayor Mitchel on April 27 vetoed the Lockwood-Ellenbogen bill which was passed by the New York Legislature ostensibly for the purpose of simplifying the inspection of buildings in New York City. His action was based upon the opinion that the bill would result in an increase in the nuisance of many inspections, and cripple the work of the Tenement House Department. Although in hearty accord with the proposal to simplify the building inspection service and reduce the number of inspections, Mayor Mitchel maintains that the bill does neither. On the contrary, it complicates the building inspection service and increases the number of inspections, makes conflict between the city departments inevitable and increases the cost to the taxpayer by $500,000 a year. He claims that it destroys the efficiency of the Tenement House Department, the only agency that in the past has stood between the unscrupulous among the builders and landlords and the welfare of more than three million people.

Connaught Bridge at Vancouver Damaged by Fire

Another serious bridge fire occurred on the morning of April 29, when about 700 ft. of the Connaught bridge at Vancouver, B. C., was burned, one span being completely wrecked. According to information from F. L. Fellows, supervising city engineer, the estimated damage is placed at about $75,000. Another fire broke out on the Granville Street Bridge while the fire on the Connaught bridge was being fought by the fire companies, and it is suspected that both fires were of incendiary origin. Only a small portion of the sidewalk of the Granville Street bridge was burned in spite of the high wind blowing at the time.

The accompanying photograph shows the wrecked portion of the Connaught bridge. This bridge was only recently completed, is about one mile long and cost $790,000. The flooring was of creosoted wood block on plank for the roadway and creosoted planking for the sidewalks. The fire seemed to originate below the floor, however, and the firemen on the bridge found it very difficult to fight the fire underneath, so that it finally broke through and caused the damage shown. A later report states that on May 3 two other attempts were made to destroy the Granville Street bridge. The flames were quickly extinguished by the fire department.

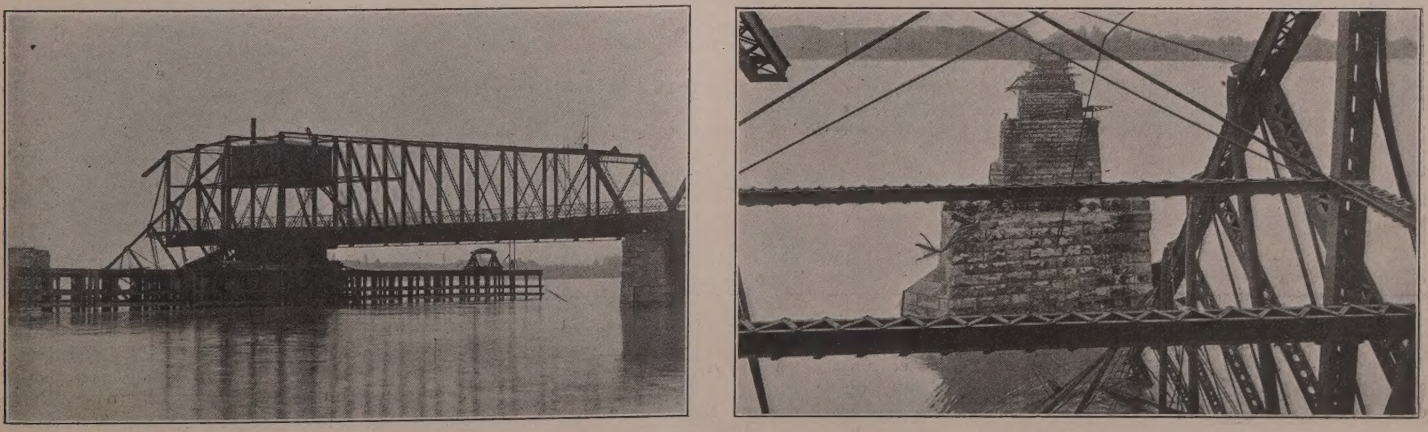
Detroit Bridge to Be Replaced on Same Site

Latest advices from City Engineer R. H. McCormick of Detroit state that the plan to construct a temporary wooden bridge to Belle Isle to replace the bridge destroyed by fire, as described on page 599 of last week's issue, has been abandoned. The $100,000 appropriated for that purpose will be used toward the erection of a new bridge on the old site as soon as plans can be prepared, utilizing the present masonry, which was practically uninjured. Bids have been received for clearing away the debris from the river channel. The Board of Supervisors killed the proposal to build a temporary bridge.

The cause of the fire is still in doubt, but the theory generally accepted is that the fire was caused by coals from an iron wagon owned by the Municipal Asphalt plant, and used to heat asphalt-laying tools. The wind carried sparks from the hardwood fuel to the Georgia pine sidewalks, which were very dry. The whole floor system of the bridge was of longleaf pine treated with creosote, and when the fire got under the bridge the stringers and floor plank burnt very freely. The accompanying photographs show how complete was the destruction of the nine 156-ft. spans and half of the drawspan.

Phoenixville Bridge Totally Destroyed by Fire

The old bridge, erected in 1830, spanning the Schuylkill River at Phoenixville, Pa., was burned early on the morning of May 9 by a fire which swept rapidly through the bridge from the Montgomery County side. The structure was entirely destroyed, the loss being estimated at about $80,000. Six members of



VIEWS OF SWING SPAN AND 156-FOOT SPANS OF BELLE ISLE BRIDGE, DETROIT, COMPLETELY WRECKED BY FIRE the local fire companies who were fighting the flames were injured. It is rumored that this fire was of incendiary origin.

Massachusetts to Spend $2,500,000 on Highways

Governor Walsh of Massachusetts has signed the bill that authorizes the construction of new State highways to the extent of $2,500,000. The roads will be built in the counties of Berkshire, Franklin, Hampden, Hampshire and Worcester, and are to be completed within the years 1915-1918 inclusive.

Jamaica Bay Improvement, New York City, to Be Resumed

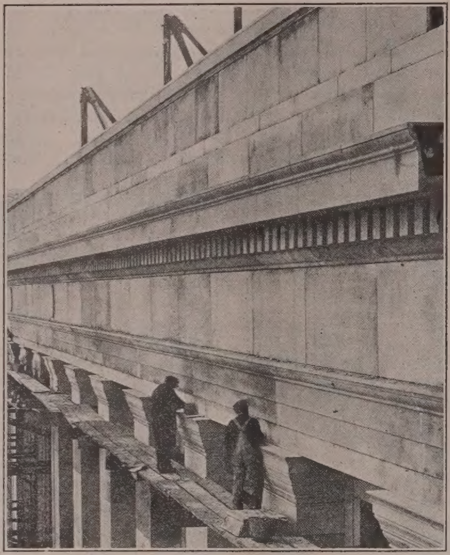
Resumption of the work of improving Jamaica Bay, New York City, was made possible last week when the Sinking Fund Commission approved the new plan of R. A. C. Smith, commissioner of docks and ferries, covering the waterfront and harbor at Mill Basin, Brooklyn.

Railway Gets Deeds for Large Tract of Land in Chicago

Deeds to the purchase by the Chicago & North Western Railway of $528,000 worth of land near One Hundred and Eighteenth Street and the Calumet River, Chicago, have just been recorded. It is believed the land is for the $4,500,000 grain elevator to be built by the Armour Grain Company.

New Technology Buildings Rapidly Nearing Completion

The new buildings being erected for the Massachusetts Institute of Technology are rapidly nearing completion. They comprise a succession of buildings increasing in height from front to rear, as described in the Engineering Record of Nov. 15, 1913, page 48, Current News Section, and April 4, 1914, page 393, and are of reinforced-concrete construction throughout. The accompanying views show the present status of the work.



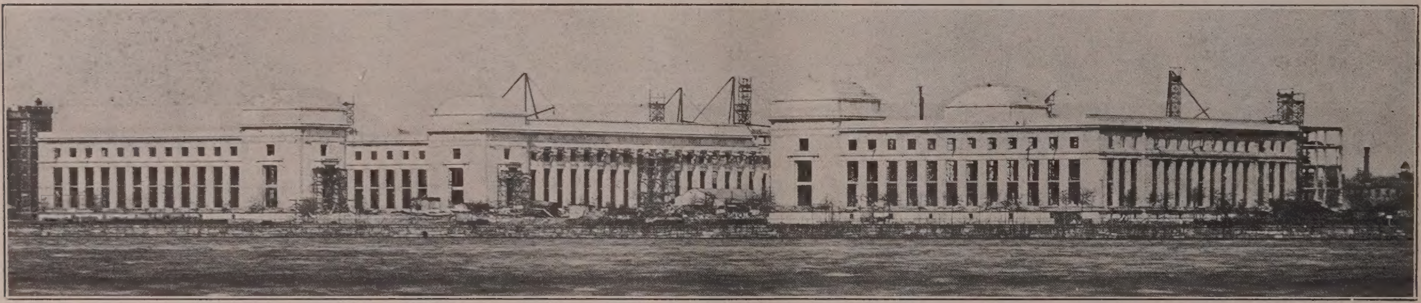
CORNICE AND PARAPET WALL

Engineers Endorse Chicago Municipal Pier

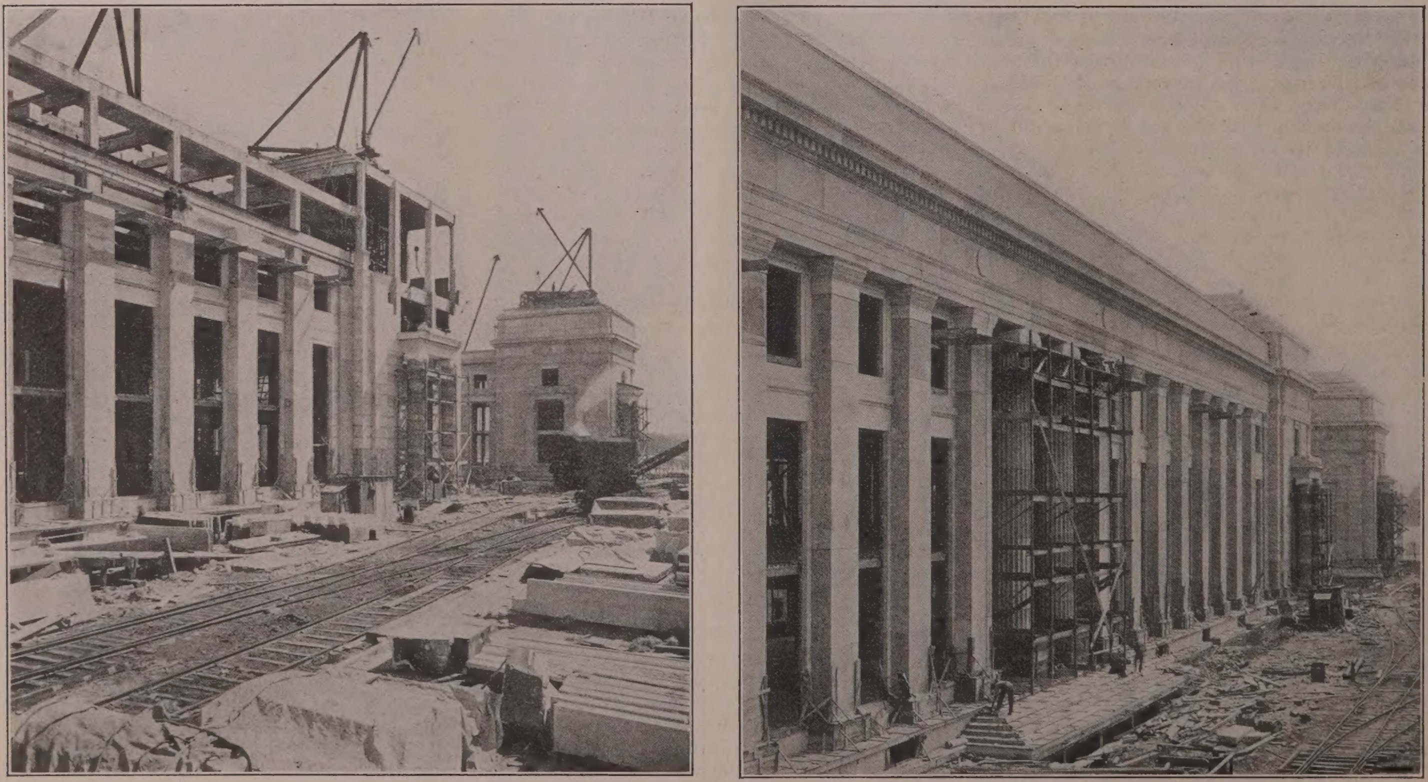
The committee of engineers asked by the city of Chicago to investigate the foundations for the new municipal pier, brought in a verdict that the present arrangement for construction of the pier, whereby the piling projects 3½ to 4 ft. above the water level, was a safe one. No violations of the building code were discovered. Col. W. V. Judson, United States engineer for the Chicago district; W. R. Patterson and C. H. Cartlidge, bridge engineer of the Chicago Burlington & Quincy Railroad, composed the committee making the report.

Highway Association and Research Bureau to Improve Road Laws

To aid Legislatures in revising road laws and in framing new legislation a series of papers dealing exhaustively with existing legislation in each State will be issued under an arrangement made by the American Highway Association with the Bureau of Municipal Research of New York City. These bodies will indicate the laws in each State which are conflicting, obsolete, vague or superfluous, and will suggest the lines along which simplicity and efficiency in revision may be obtained.



NEW GROUP SEEN TO BEST ADVANTAGE FROM ACROSS CHARLES RIVER. GREAT DOME NOT YET ERECTED



RAPIDITY OF CONSTRUCTION VISUALIZED. TWO PICTURES OF SAME BUILDING TAKEN ONE MONTH APART

Models for laws covering State aid improvements, the use of convict labor, the issuing of bonds for road construction, the management of traffic and other related subjects of legislation will likewise be suggested. Charts will be used to show variations in practice in the several States.

Texas Good Roads Association to Meet August 4-5

The Texas Good Roads Association, together with the County Judges and Commissioners Association of that State, will hold a meeting at the Agricultural and Mechanical College of Texas, Aug. 4-5, as guests of the college highway engineering department. A program of addresses together with round-table discussions of practical value is being planned for the occasion.

Pennsylvania to Have "Good Roads Day"

Governor Brumbaugh, of Pennsylvania, has issued a proclamation fixing May 26 as "Good Roads Day" in that State. In it he expresses a desire to stimulate a wider and more intelligent interest in the good roads movement, and calls upon every able-bodied citizen either to give one entire day to the improvement of the local highways or to contribute in money the wages of a laborer.

John Scott Legacy Medal Awarded

The city of Philadelphia, upon the recommendation of the Franklin Institute, has awarded the John Scott Legacy Medal and Premium to Herbert A. Humphrey, of London, Eng., and to Alberto Cerosoli of Rome, Italy, for the Humphrey pump, a device for raising water by the direct application of the explosive energy of a mixture of combustible gas and air. The first installation of pumps of this type in the United States was described in the Engineering Record of May 8, 1915, page 596.

Preparing for Conference on Concrete Road Building

It is proposed that the Second National Conference on Concrete Road Building be held in Chicago in February, 1916, and in preparation for it the advisory committee is now being enlarged. It was agreed at the first conference held in Chicago in February, 1914, that another conference should be held. Details of arrangements are in the hands of the secretary, J. P. Beck, 208 S. La Salle St., Chicago.

Designate Pan-American Road Congress Day at Exposition

At the meeting of the executive committee of the Pan-American Road Congress, on May 10, the proposition of the authorities of the Panama-Pacific International Exposition to designate Sept. 15 as Pan-American Road Congress Day was accepted.

Is a Hotel "Operative Property" of a Railroad ?

In the case of a road used for scenic purposes exclusively, can the grounds and hotel be considered "operative property" for rate-fixing purposes? This was the question that Commissioner Loveland of the Railroad Commission of California was recently called upon to decide in the case of the Mt. Tamalpais & Muir Woods Railway. After listening to a detailed presentation of the facts he intimated that in his opinion this scenic road must be considered in a class by itself, and that the hotel and tavern it owns constitute an operative part of the railroad system.

The values of the Mt. Tamalpais & Muir Woods Railway, including the resorts at the terminals on the mountain top and in Muir Woods, has been established at about $446,000, and of this amount $105,000 represents the value of the hotels and their surrounding grounds.

Nicholas S. Hill, Jr., Elected President of Waterworks Association

Nicholas S. Hill, Jr., consulting hydraulic and sanitary engineer, was elected president of the American Waterworks Association at the annual convention at Cincinnati this week.

Consulting Engineer of New York, Who Was Elected President of American Waterworks Association

NICHOLAS S. HILL, JR.

Mr. Hill was graduated from Stevens Institute of Technology in 1892 and was engaged by the South Side Elevated Railroad of Chicago as mechanical engineer, having supervision over the construction of rolling stock. He attained the grade of chief mechanical engineer of this company previous to 1893, when he resigned to return to Baltimore as secretary of the sewerage commission. In May, 1894, he was appointed engineer to the electrical commission of that city in charge of the building of a subway system for the police and fire-alarm wires, and later was appointed chief engineer of the water department. In this office his work attracted such attention as to result in his being offered the office of chief engineer of the New York City water department. In this capacity he established new standards for pipes and castings and reorganized the department completely. Upon retiring from this office he entered private practice as consulting hydraulic and sanitary engineer, in New York City.

Proposes National Waterworks Association

A National waterworks association, consolidating the various existing organizations, was a radical measure proposed by George G. Earle in his presidential address at the opening session of the convention of the American Waterworks Association, at Cincinnati, May 11. The convention opened with the Hotel Gibson ballroom filled to capacity, with a registered attendance of 650.

An Iowa and a Central States section of the association have been formed and Allen Hazen reported the probability of a California section being organized. Nicholas S. Hill, Jr., of New York, was elected president of the association; Leonard Metcalf, of Boston, vice-president; J. M. Caird, of Troy, N. Y., treasurer, and Carleton E. Davis, of Philadelphia, and Charles H. Rust, of Victoria, B. C., trustees.

The next convention of the Association will be held in New York City.

To Fix Dixie Highway Route

The location of the proposed Dixie highway, from Chicago to Miami, Fla., will be determined at a meeting of the Dixie highway commissioners at Chattanooga, Tenn., May 20. The Commissioners were appointed by the governors of the seven States through which the highway is projected. Clark Howell of Atlanta was elected permanent chairman, April 23, and W. W. Marr, Illinois State highway engineer, secretary. Advocates of the various routes suggested for the highway submitted data on May 10 to each commissioner on the route which they favored.

Cooley Retains Position with Sanitary District

Lyman E. Cooley still remains as consulting engineer of the Sanitary District of Chicago as the result of a veto by the president of the board. The action of dismissing Mr. Cooley was taken during the president's absence. It was then declared that the president had no power to take such action and the veto was referred to the finance committee, where on May 5 a tie vote resulted. Mr. Cooley, therefore, retains his position.

U. S. Geological Survey Sends Twelve Parties to Alaska

The United States Geological Survey is dispatching twelve parties to Alaska to continue the systematic surveys and investigations that have been in progress for the last 18 years. These parties will sail from Seattle this month, so as to take full advantage of the field season. All the men needed for the work have been engaged, and the purchase of horses, supplies and equipment is well under way.

New York Appropriates $995,000 for Long Island Marginal Canal

A bill appropriating $995,000 to secure right of way for a canal connecting the bays on the south side of Long Island, to be built by the Federal Government, was passed by the recent New York Legislature, and has been signed by Governor Whitman. The appropriation is contingent on the Federal Government taking proper action to make certain the accomplishment of the work.

City of Buffalo Must Maintain Chicago Street Viaduct

That the city of Buffalo must maintain the Chicago Street viaduct over the Erie Railroad is established by a recent decision of the Court of Appeals. The matter was brought to a decision in a suit to test the grade-crossing agreement of 1888, under which the earliest grade-crossing elimination work was carried out. The later agreements impose the maintenance of the overhead viaducts on the railroads, but under the first arrangement the railroads paid a larger percentage of the cost, and the city, the railroads contended, were bound to maintain the bridges. This decision appears to sustain their contention.

Ask Establishment of State Highway Department for Wyoming

The press of Wyoming is advocating the immediate establishment of a Wyoming State highway department. Observation of the results secured where highway work is under State control as compared with county or township management is said to be at the bottom of the campaign.

Newburgh Adopts Commission Government

Newburgh, N. Y., in an election held May 1, adopted a new charter, which provides for a commission form of city government and a city manager.

News of Engineering Societies

The Engineers' Club of Trenton held a special meeting, May 3, for the purpose of discussing with Mayor F. W. Donnelly the Trenton water power and its utilization for power purposes.

The American Public Health Association will hold its annual meeting at Rochester, Sept. 7-10, under the presidency of Prof. W. T. Sedgwick of the Massachusetts Institute of Technology.

The Colorado Association of members of the American Society of Civil Engineers will hold a meeting in Denver, May 15. J. E. Maloney, secretary-engineer of the Colorado Highway Commission, will address the meeting on "Colorado State Highways." A trip to Pueblo is being discussed. The plan is for those going from Denver to leave Friday night, June 11. spending Saturday at the steel works of the Colorado Fuel & Iron Company, the plant of the Eliot Frog & Switch Company and returning that night.

Personal Notes

R. L. Reading has been appointed city engineer of Redding, Cal.

H. A. Perkins has been appointed city engineer of Leavenworth, Kan.

C. D. Shauver has been appointed assistant State engineer of Wyoming.

John B. Otto has been reappointed city engineer of Williamsport, Pa.

H. Moseley has been appointed city engineer of Dallas, Tex., succeeding J. M. Preston.

L. H. Brady has been appointed city engineer of San Bernardino, Cal., succeeding F. A. Smith.

Edwin D. Vincent, construction engineer of the Board of Harbor Improvements, Los Angeles, has resigned.

C. W. Anderson has been appointed city engineer of Centralia, Wash. He succeeds Stanley Macomber, resigned.

F. H. Villie, city engineer of South Bethlehem, Pa., has resigned to engage in private practice as consulting engineer.

R. O. Hollenbeck has been appointed assistant to H. E. Breed, first deputy highway commissioner of New York State.

E. M. Capps, formerly supervising engineer of harbor improvements at San Diego, Cal., has been elected mayor of that city.

Charles S. Hepner has been reappointed city engineer of Freeport, Ill. A. C. Dresser has been appointed assistant city engineer.

H. B. Cartwright, acting assistant engineer of the Seaboard Air Line Railway at Jacksonville, Fla., has been appointed assistant engineer.

Col. L. H. Beach, Corps of Engineers, U. S. A., who has been in charge of harbor and fortification works at Baltimore, has been ordered to take charge of the engineering operations in the Cincinnati district.

E. E. Calvin, vice-president and general manager of the Oregon Short Line, has been appointed first vice-president of the Salt Lake Route, succeeding the late W. H. Bancroft. Mr. Calvin entered the railway service in 1873.

J. B. Hunley has been appointed engineer of bridges and structures of the Cleveland, Cincinnati, Chicago & St. Louis Railway, succeeding O. E. Selby, whose promotion to a higher grade is noted elsewhere in these columns.

A. C. Lee has been appointed resident engineer on the new hydroelectric development work of the Southern Power Company at Fishing Creek, near Nitrolee, S. C., construction work upon which, it is expected, will be started in the near future.

Charles P. Light, field secretary of the American Highway Association, has been loaned by the directors of that organization to the Pan-American Road Congress until the close of the meeting to be held by that body in Oakland, Cal., during the week of Sept. 13.

Lamar Lyndon, consulting engineer of the Austin (Texas) Dam, and Frank S. Taylor, resident engineer, have resigned from their respective offices. The engineering work in connection with the dam will hereafter be taken care of by J. G. White & Company, of New York.

Samuel M. Young, engineer for the Board of Commissioners of the Port of New Orleans, has resigned for the purpose of devoting himself more closely to his private practice as a member of the firm of Guerin & Young, consulting engineers, of that city. Mr. Young asked to be relieved May 1, but was requested to extend the time to June 1.

J. E. Cassidy, formerly consulting engineer for the Edison Portland Cement Company, at Philadelphia, and C. M. Foster, formerly district manager of the same company, have organized the Foster Construction Company with main offices in the Kinney Building, Newark, N. J., for the purpose of engaging in a general engineering and contracting business, giving special attention to the design and construction of concrete structures of all classes.

William S. Moore, formerly city engineer of South Bend, Ind., has been appointed city engineer of Grand Rapids, Mich. He was appointed assistant city engineer of South Bend soon after graduation from Purdue University in 1898 and remained in that office until 1904, when he became city engineer of Mishawaka, Ind. In 1910 he returned to South Bend as city engineer and held that office until his appointment to the Grand Rapids office.

Howard W. Holmes, formerly chief of the Bureau of Highways and Bridges of the city of Portland, Ore., has been appointed assistant State highway engineer of Oregon. He was graduated from the Van der Naillan School of Engineering, San Francisco, in 1907, and has been engaged as a civil engineer since that time, having had to do with water development work, highways, municipal work, design and construction of timber and concrete structures in connection with irrigation, mining work and bridge construction.

O. E. Selby, engineer of bridges and structures of the Cleveland, Cincinnati, Chicago & St. Louis Railway, has been appointed principal assistant engineer with headquarters at Cincinnati. He was educated at the State University of Iowa and entered the railway service in 1885 as a draftsman on the Chicago, Burlington & Northern. In 1887 he entered the service of the Illinois Valley & Northern, and in 1888 that of the Elgin, Joliet & Eastern. In 1889 he was appointed assistant engineer on the Louisville & Jeffersonville Bridge across the Ohio River, and in 1891 became resident engineer on the same work. In 1892 he went to Cuba as resident engineer on a dock being built by the Spanish-American Iron Company near Santiago. He entered the service of the Cleveland, Cincinnati, Chicago & St. Louis Railway in 1899 as an assistant engineer, and became bridge engineer in 1905.

Obituary Notes

William M. Connell, formerly an engineer in the department of sewers of Chicago, died at Albuquerque, N. M., May 8.

Edmund K. Turner, formerly consulting engineer of the Massachusetts Railroad Commission, died at Brookline, Mass., last week at the age of sixty-seven. Mr. Turner was a native of Marblehead, Mass., and was educated at the Massachusetts Institute of Technology. He was employed for some years by the Fitchburg Railroad and later was in consulting practice in Boston. He served as consulting engineer of the Massachusetts Railroad Commission for a considerable period.

Civil Service Examinations

Examinations Previously Announced

Date.		See Eng. Record.
May 15	—Inspector of construction, State of New York; salary $3.50 to $4.50 per day	April 24
June 3	—Transitman, Philadelphia; salary $900	April 24
June 4	—Second assistant, salary $1000; assistant engineer, salary $4000; Philadelphia	April 24
June 5	—Assistant railroad engineer, State of Illinois	May 8

Business Notes

The Continental Car Company, of Louisville, Ky., has succeeded to the business of the Continental Car & Equipment Company and will continue the manufacture of Continental dump cars and, also, of mine, quarry and all types of industrial cars.

The Pennsylvania Drilling Company, of Pittsburgh, has assumed the business formerly conducted by the J. A. Brennan Drilling Company. This is merely a change of names, the management remaining the same. The office which was located at Scranton, Pa., has been moved to the Whitehall Building, New York City.

The International High Speed Steel Company, of 478 Pearl Street, New York City, has almost completed its steel plant at Rockaway, N. J., which is expected to go into full operation by the latter part of June. The products of this plant will include hollow hexagon and round rock-drill steels of the "Bulldog" brand.

Charles W. Sherburne, head of the contractors and railroad supplies firm of Sherburne & Company, Boston, Mass., died in Boston on May 7. Mr. Sherburne was born in Boston seventy-six years ago and at an early age entered the employ of the Vermont & Canada Railroad. Later he was president of the Armstrong Transfer Company and of the Star Brass Manufacturing Company, Boston.

Trade Publications

The following companies have recently issued trade literature:

Koehring Machine Company, Milwaukee. Catalog, 98 pages, illustrated. Describes Koehring mixers in detail and pictures them in connection with numerous jobs.

Calumet Steel Company, 208 South La Salle Street, Chicago. Catalog, 6 x 9¼ in., 64 pages, illustrated. A descriptive discussion on reinforcing rail-steel bars and their manufacture, with some illustrations of modern buildings reinforced with the Calumet rail-steel product.

Dominion Bridge Company, Montreal, Canada. Catalog S. 1, 11½ x 8½ in., 104 pages, illustrated. Contains descriptions and illustrations of the shops of the Dominion Bridge Company and many recently erected steel bridges, buildings, plants and other steelwork throughout Canada as constructed by this company.